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(54) **GOLF CLUB AND GOLF CLUB HEAD STRUCTURES**

(75) Inventors: **John T. Stites**, Weatherford, TX (US); **Robert Boyd**, Flower Mound, TX (US); **Eric A. Larson**, Arlington, TX (US); **Kenneth W. Brown**, Tolland, CT (US); **Sherry L. Jones**, Pataskala, OH (US); **Yoshimasa Fujita**, Ping-Tung Hsien (TW)

(73) Assignee: **NIKE, Inc.**, Beaverton, OR (US)

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See application file for complete search history.

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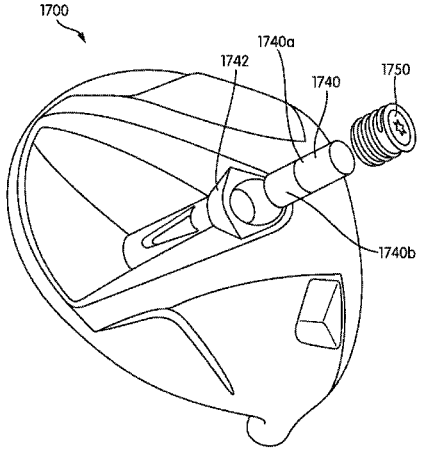
Primary Examiner — Alvin Hunter
(74) *Attorney, Agent, or Firm* — Banner & Witcoff, Ltd.

(57) **ABSTRACT**

A golf club head has a body defining a ball striking face. The body further has a first leg extending away from the ball striking face and a second leg extending away from the ball striking face wherein a void is defined between the first leg and the second leg. The body further defines a cover that extends over the void. The golf club head may further have support structures and adjustable weight members.

17 Claims, 47 Drawing Sheets



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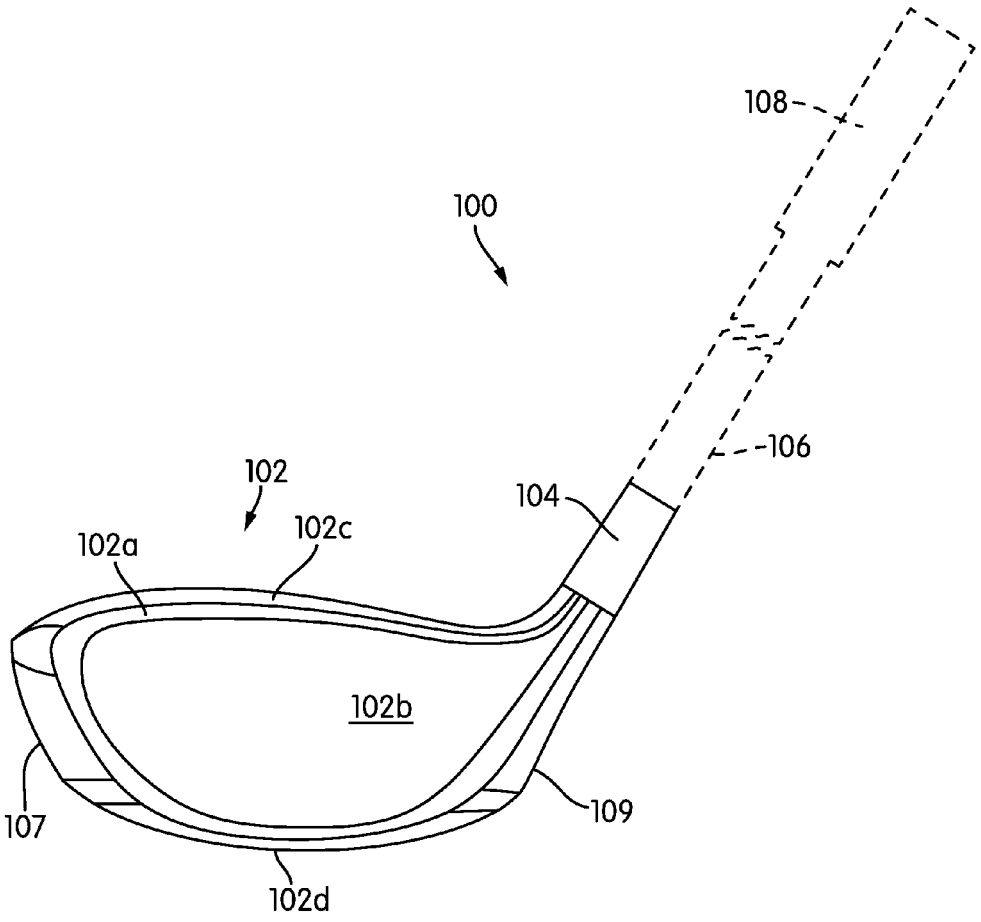

FIG. 1A

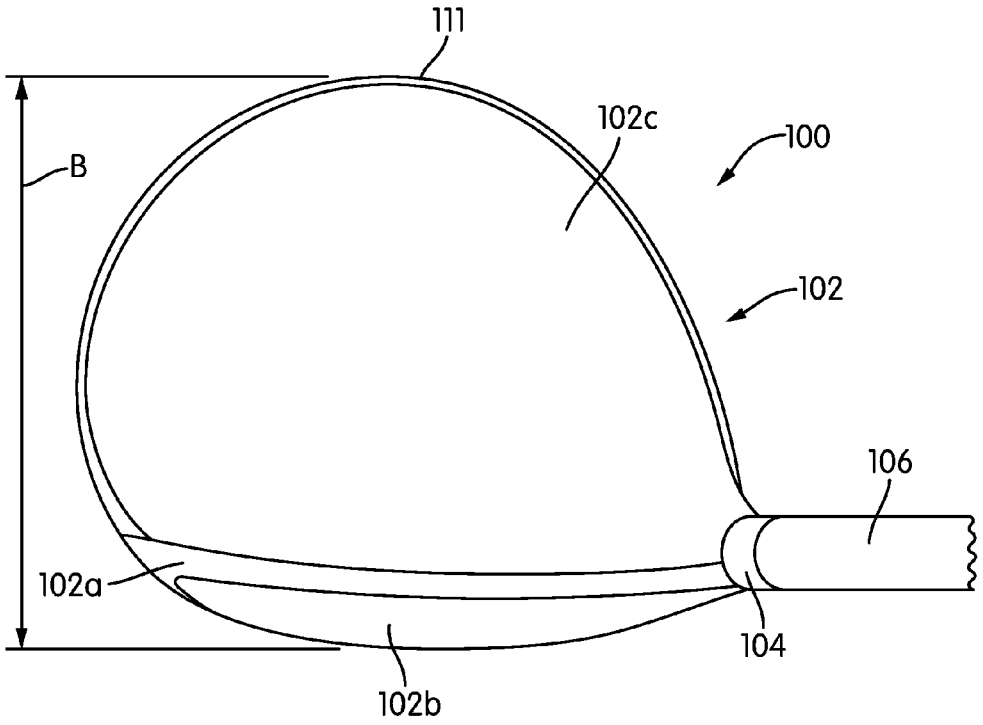

FIG. 1B

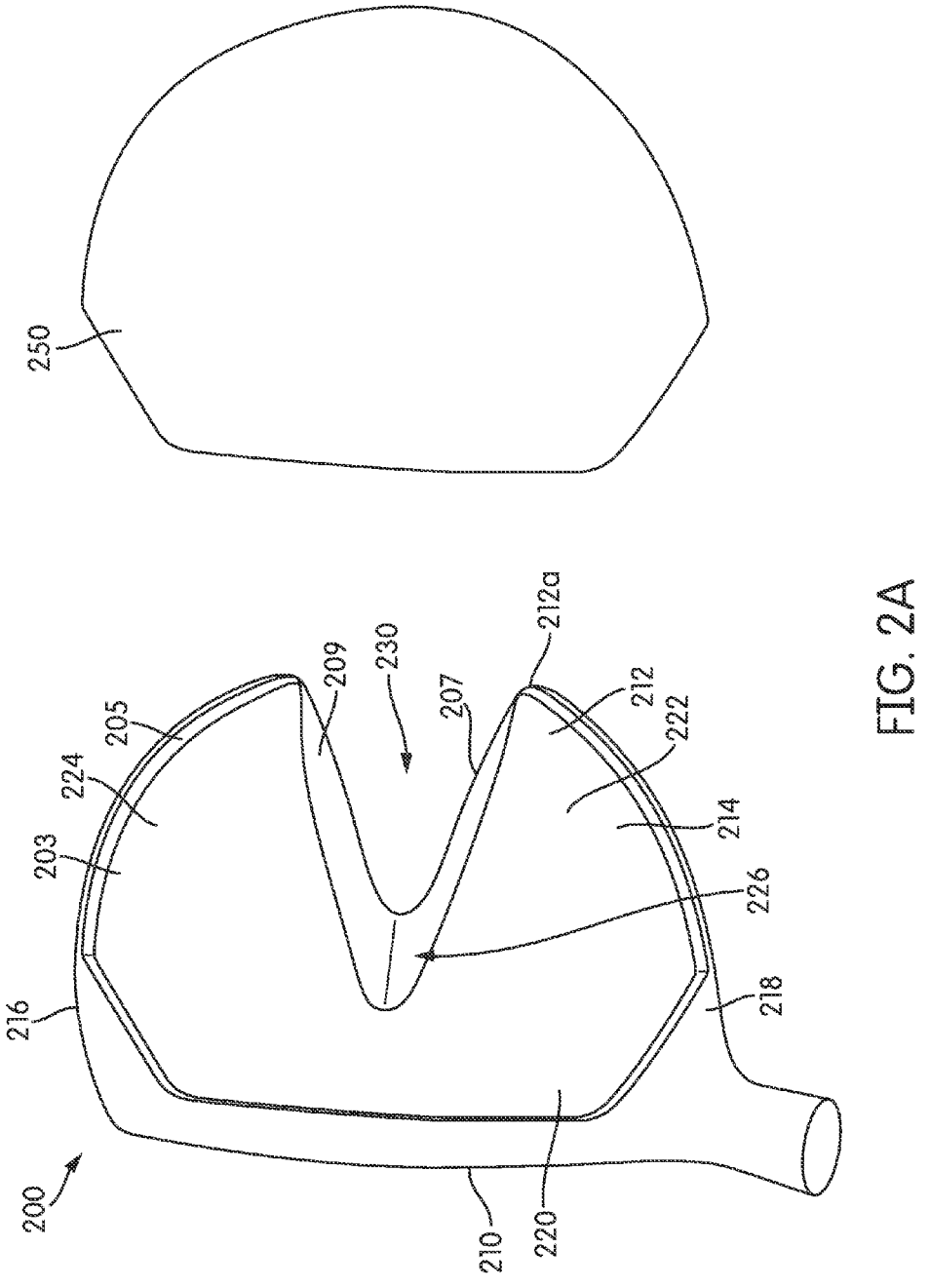
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FIG. 2A

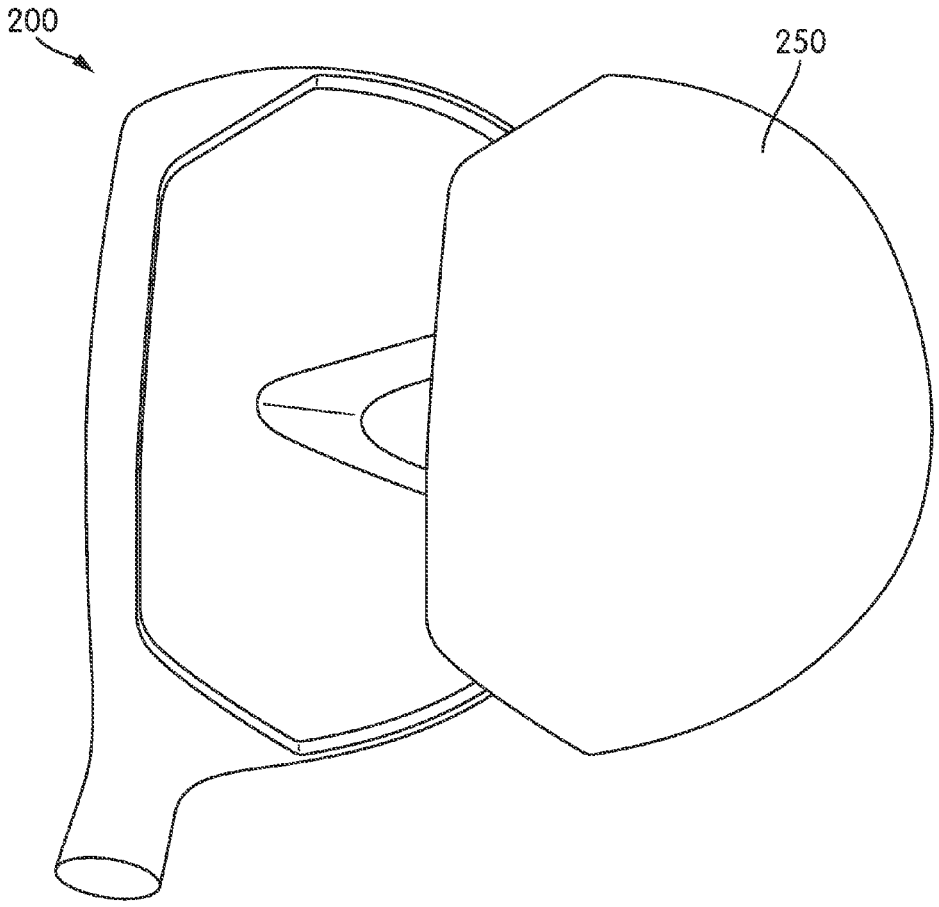

FIG. 2B

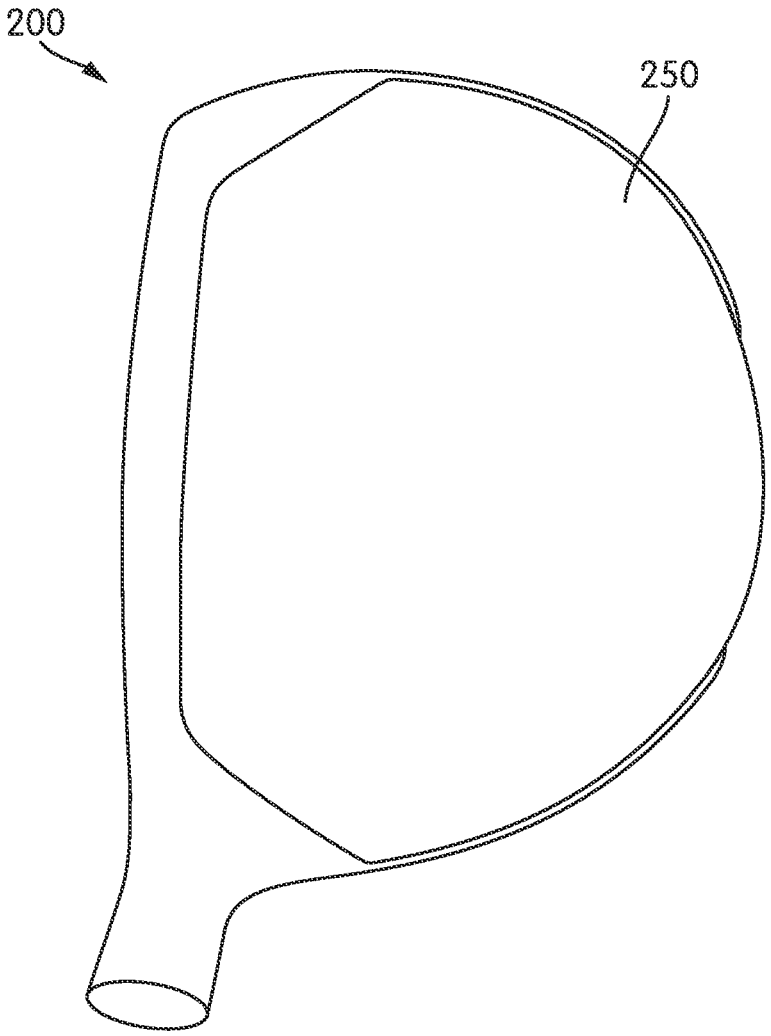

FIG. 2C

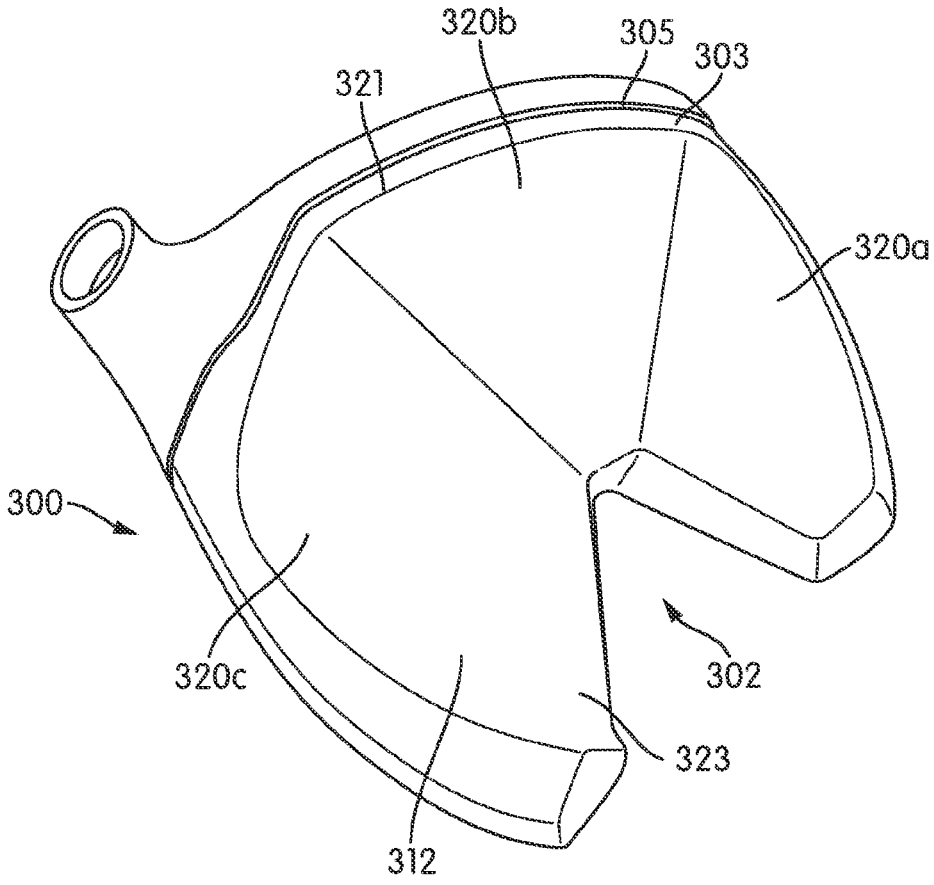

FIG. 3A

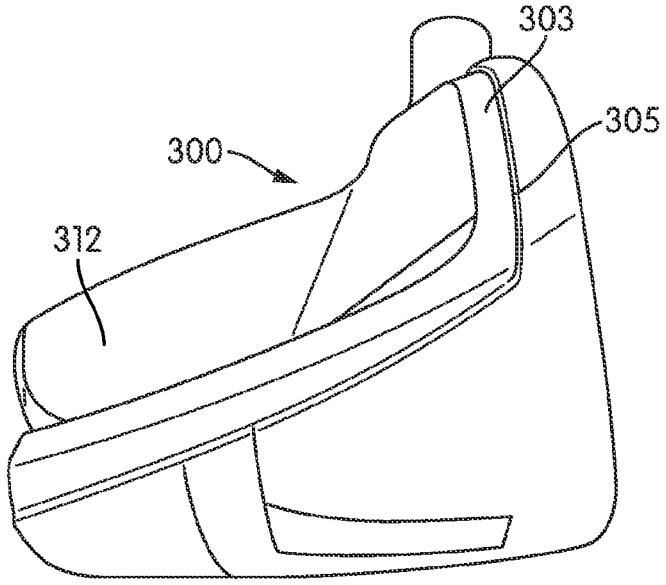

FIG. 3B

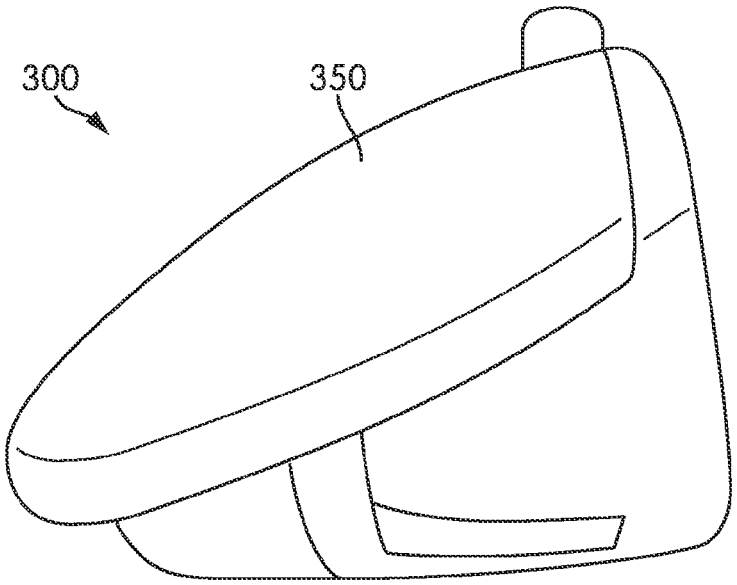

FIG. 3C

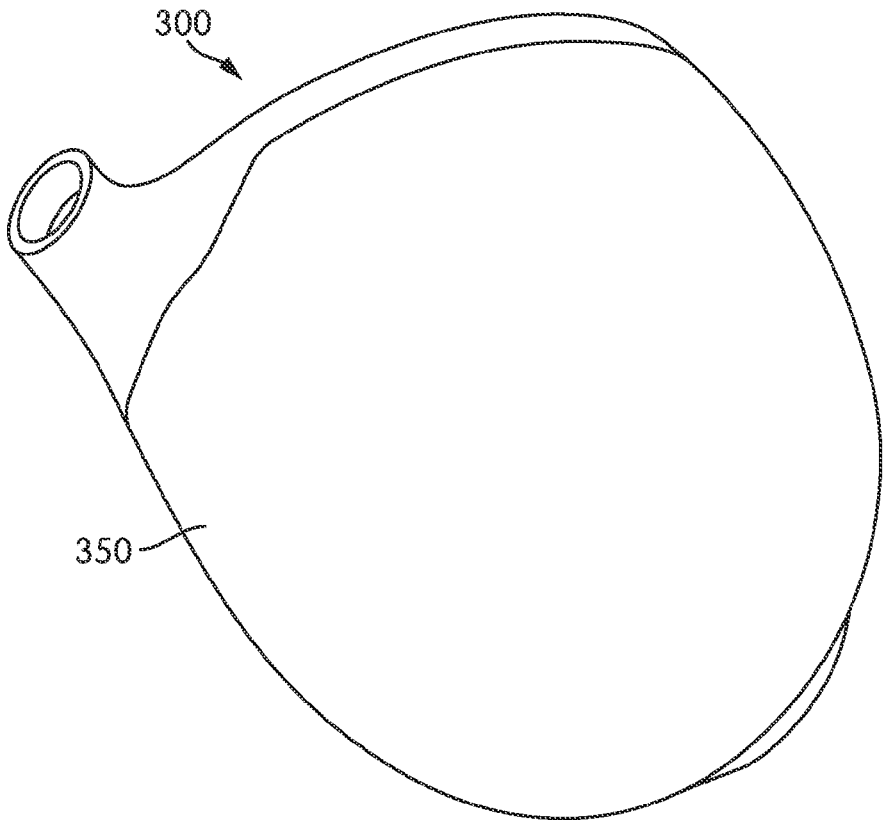

FIG. 3D

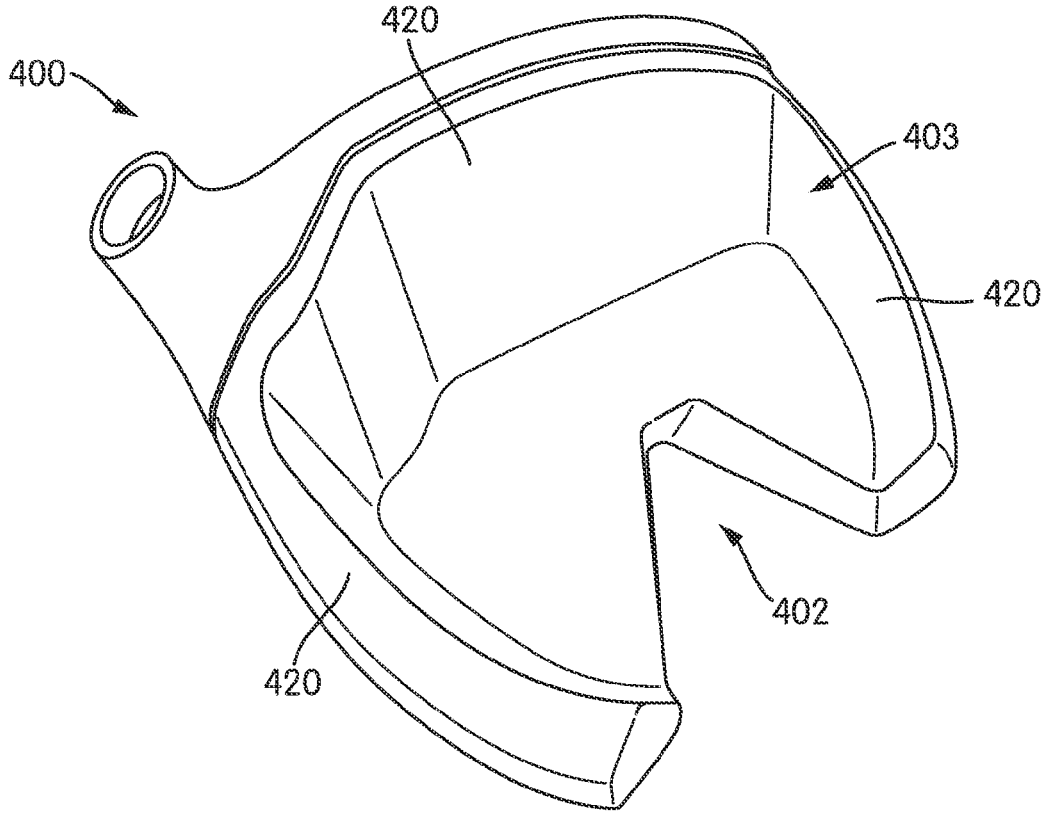

FIG. 4A

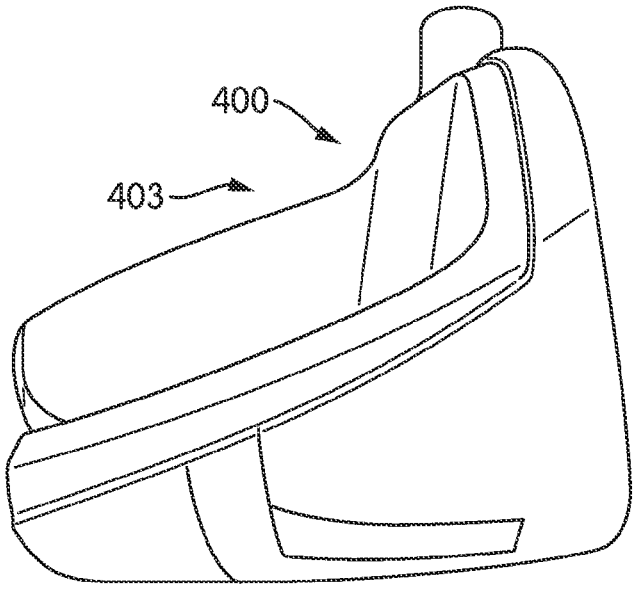

FIG. 4B

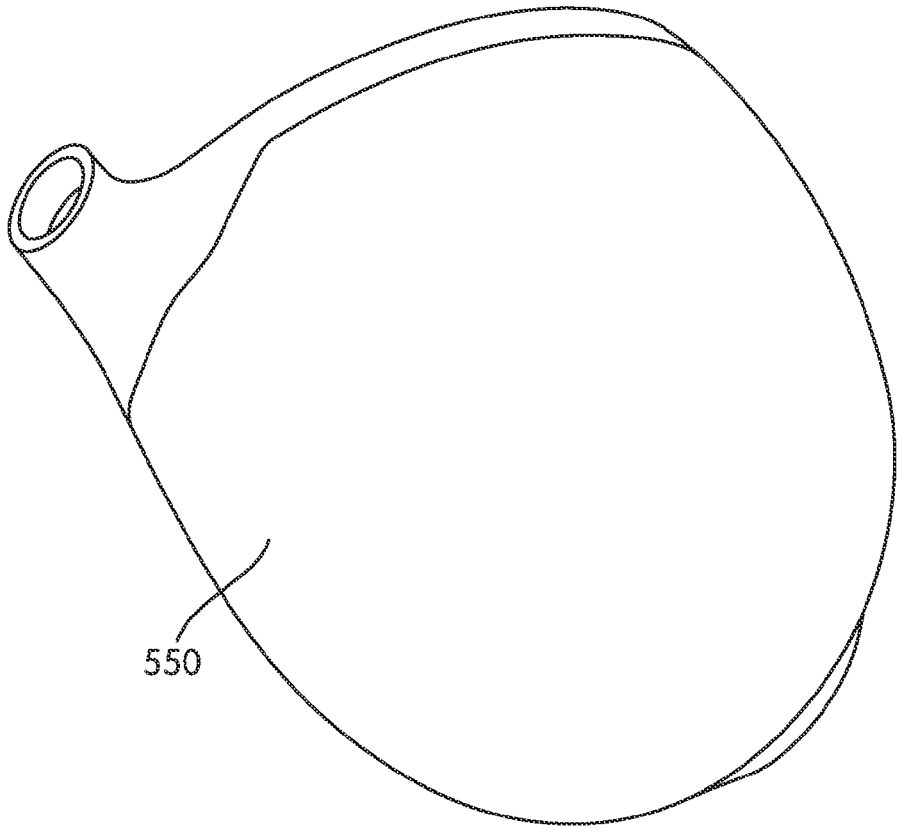

FIG. 5A

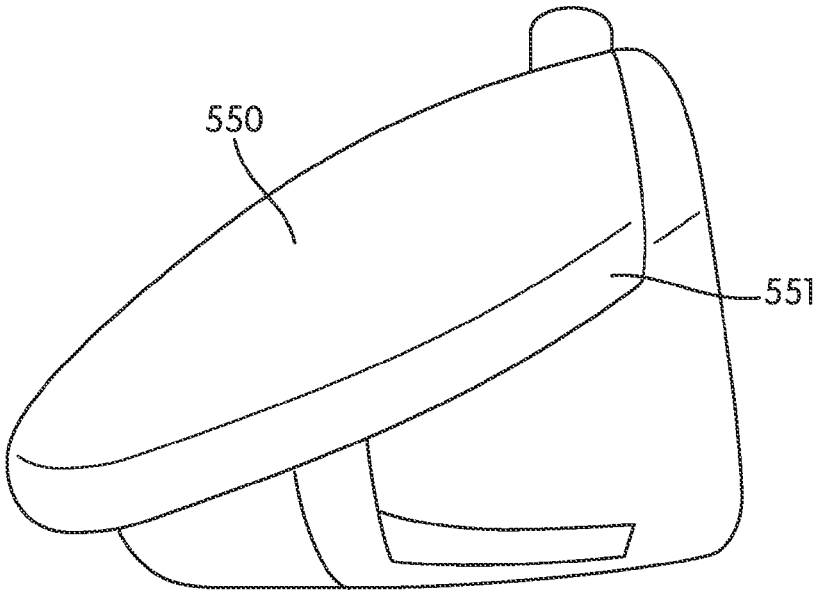

FIG. 5B

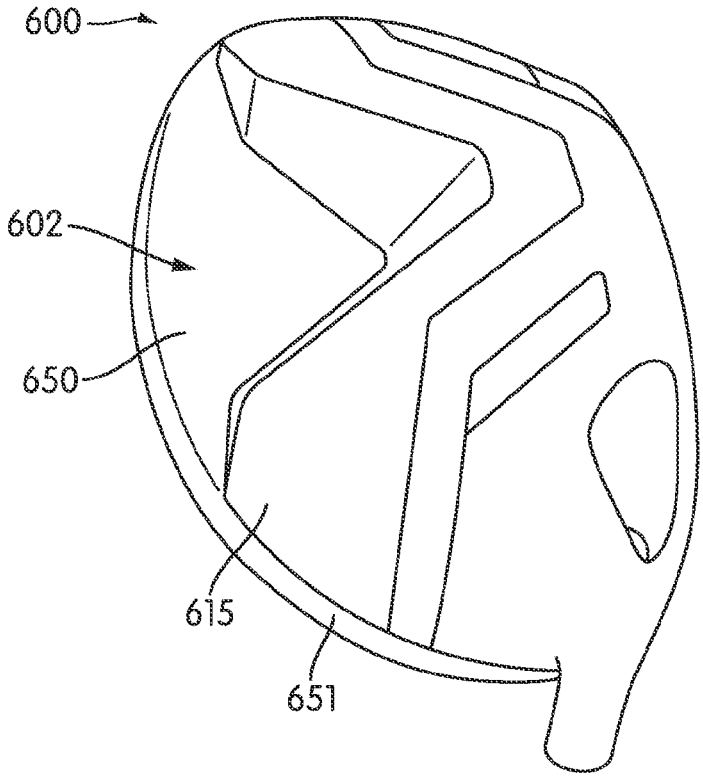

FIG. 6A

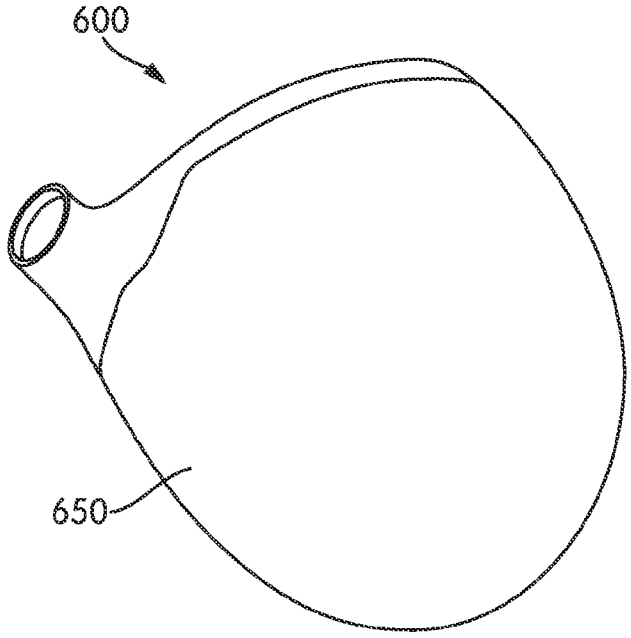

FIG. 6B

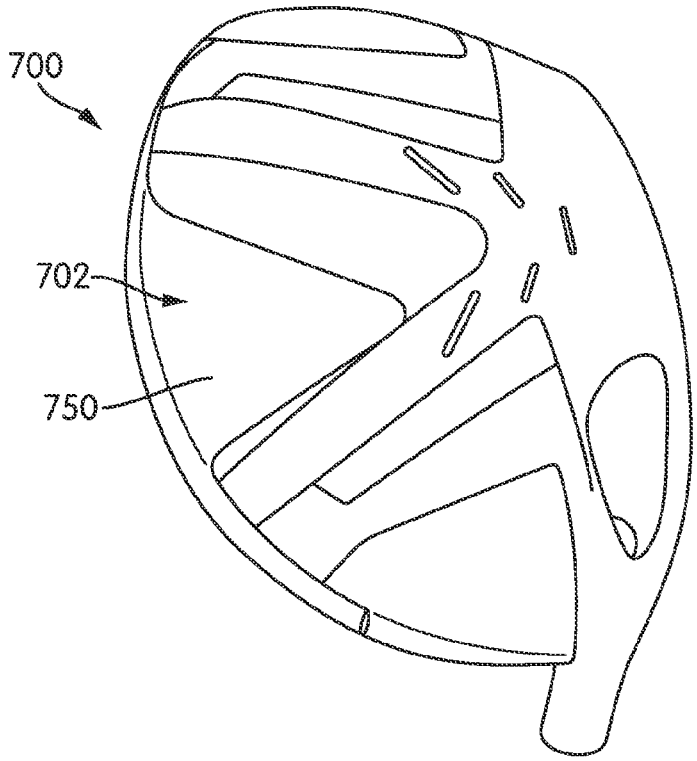

FIG. 7A

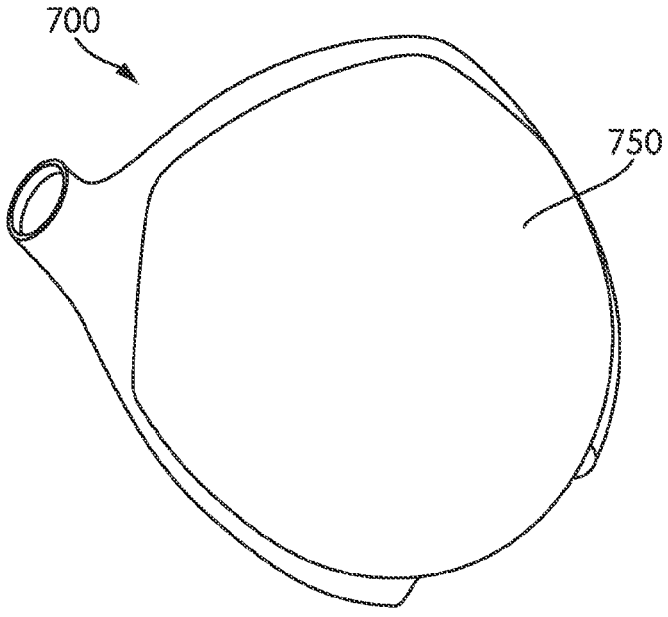

FIG. 7B

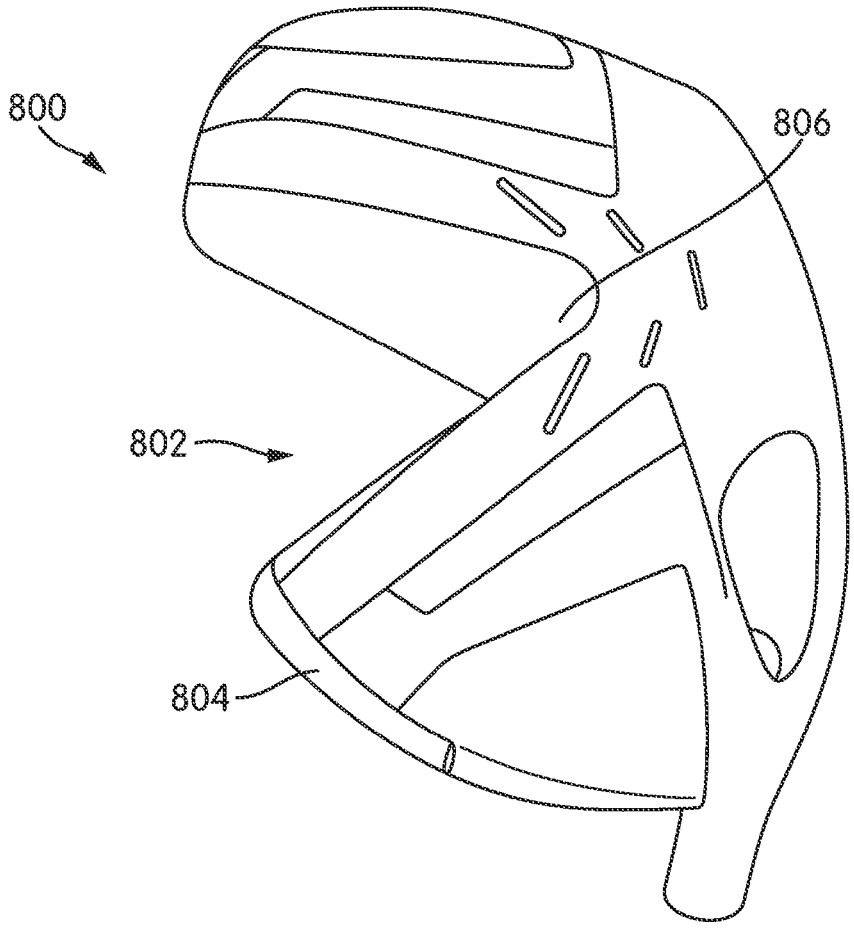

FIG. 8A

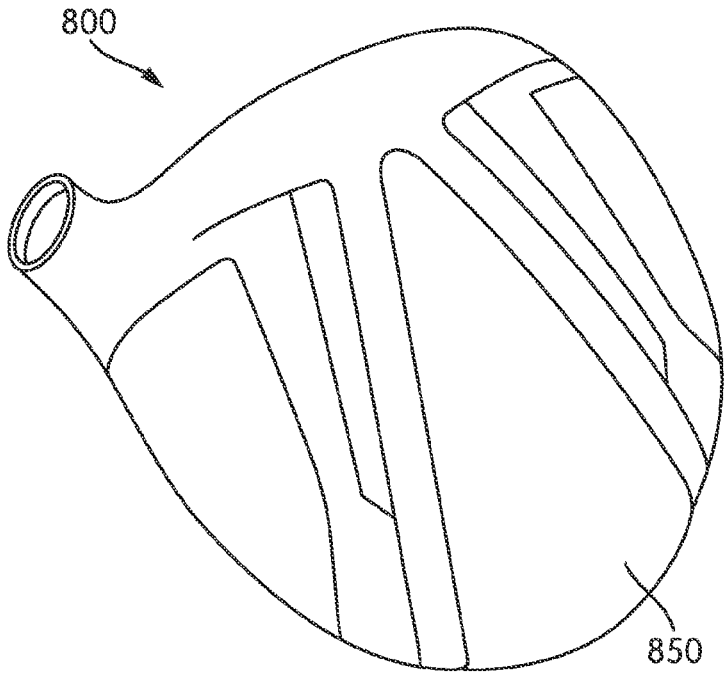

FIG. 8B

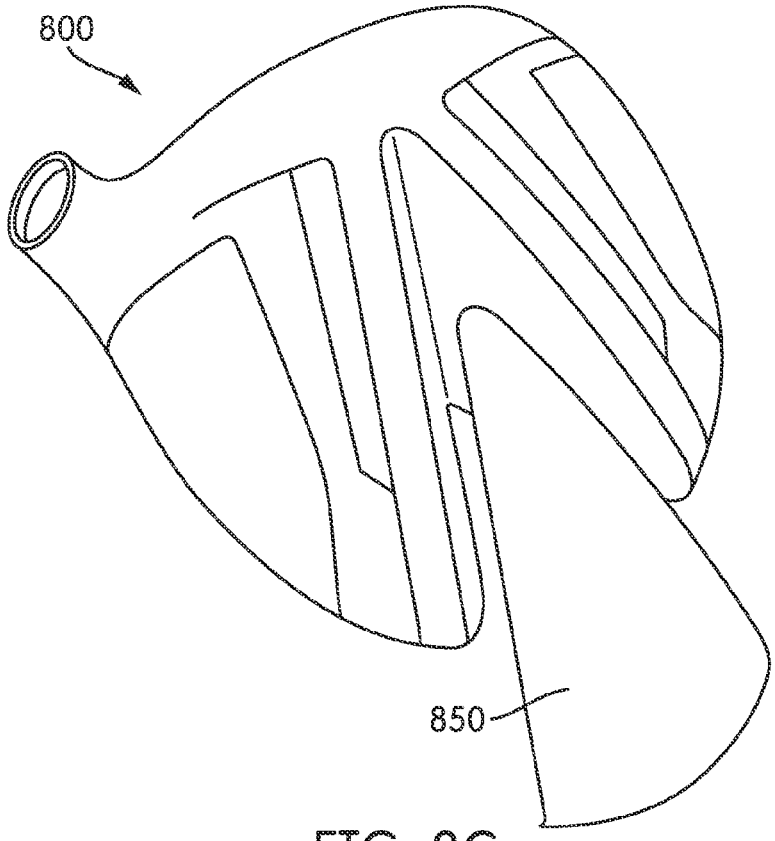

FIG. 8C

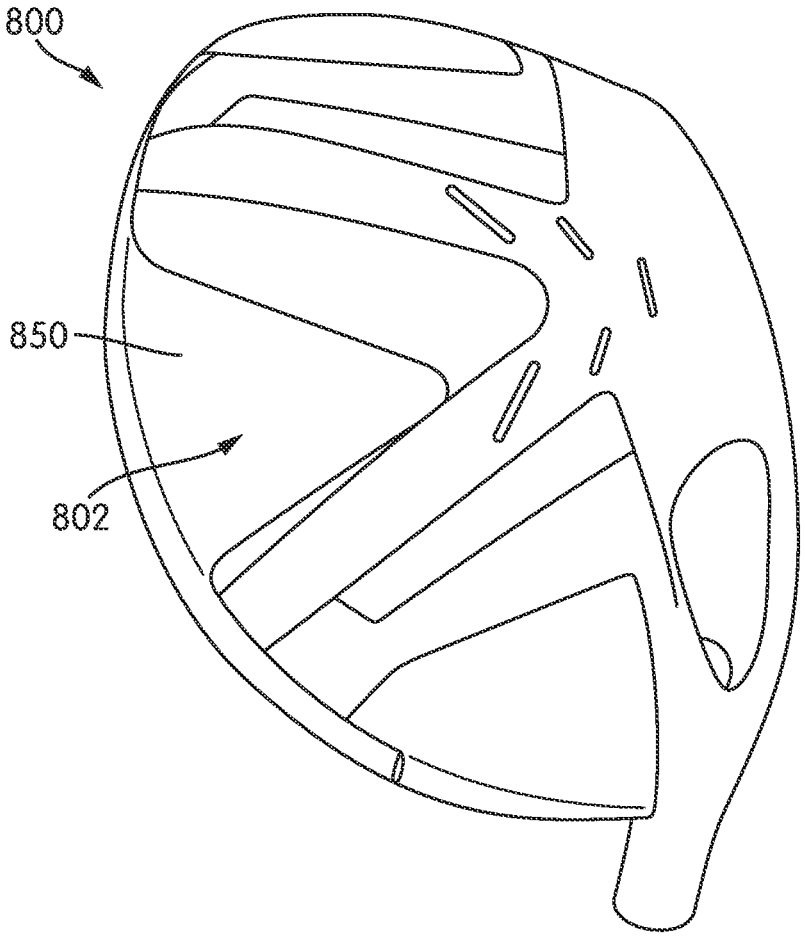

FIG. 8D

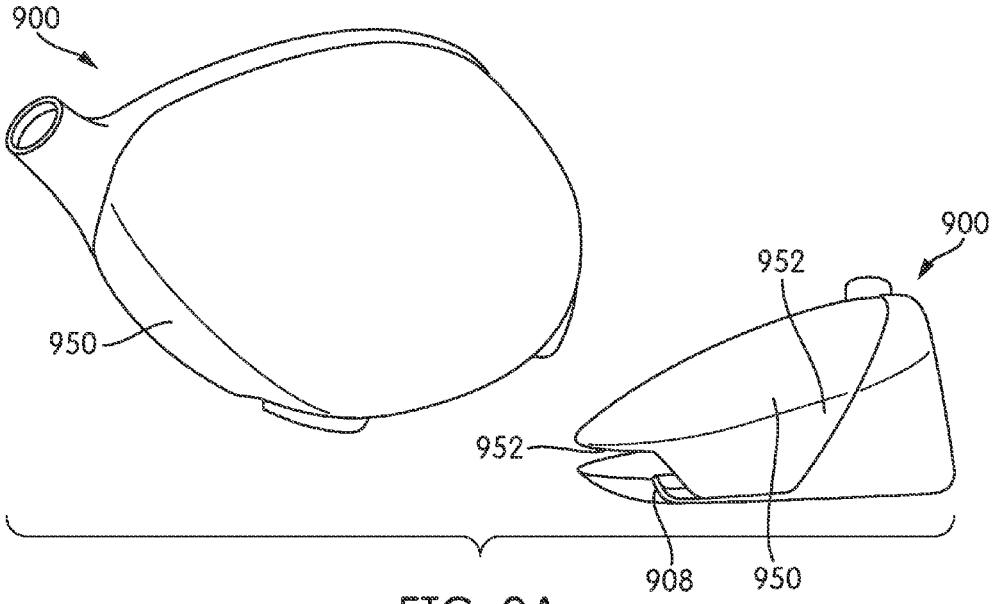
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FIG. 9A

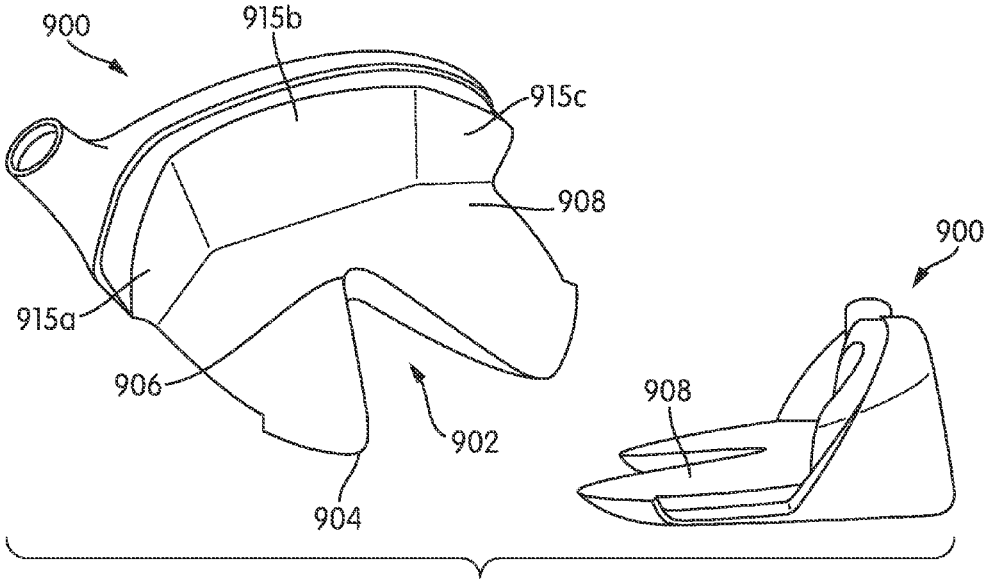
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FIG. 9B

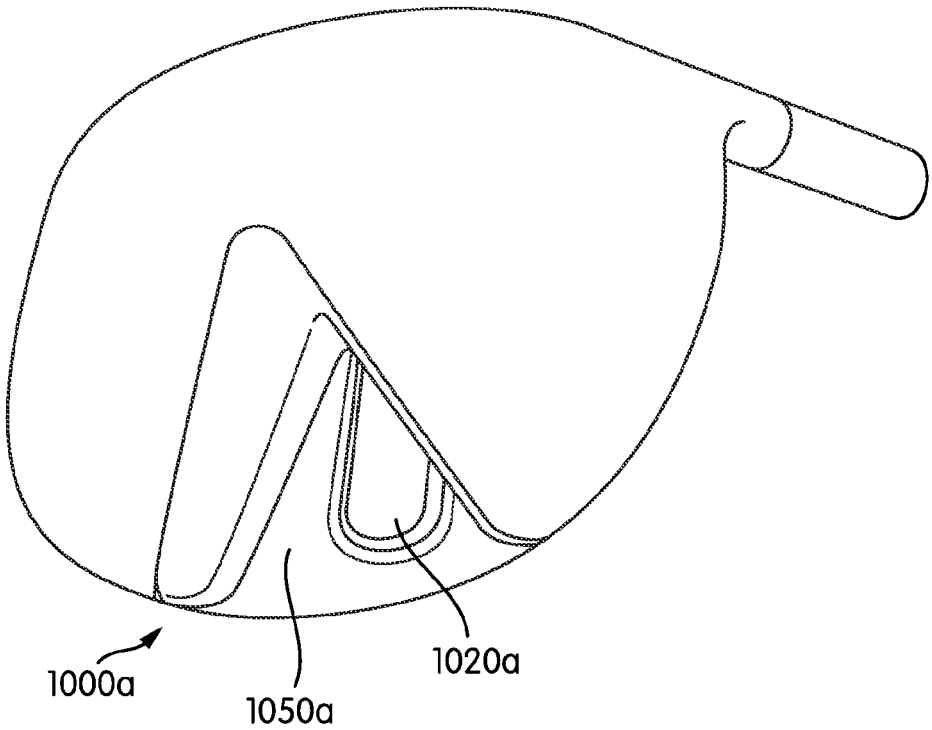


FIG. 10A

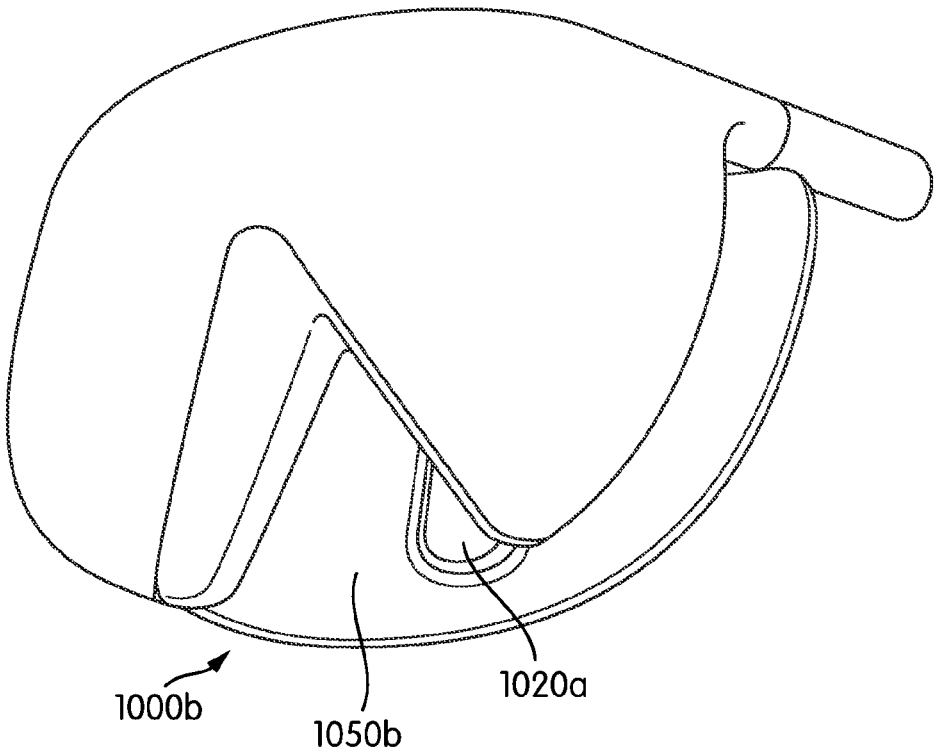


FIG. 10B

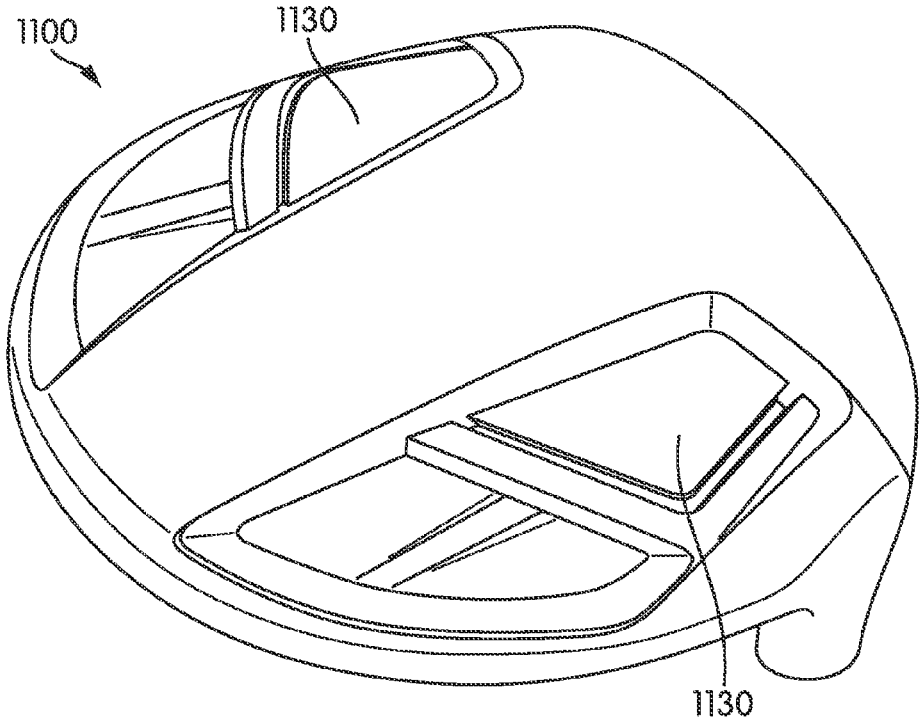


FIG. 11

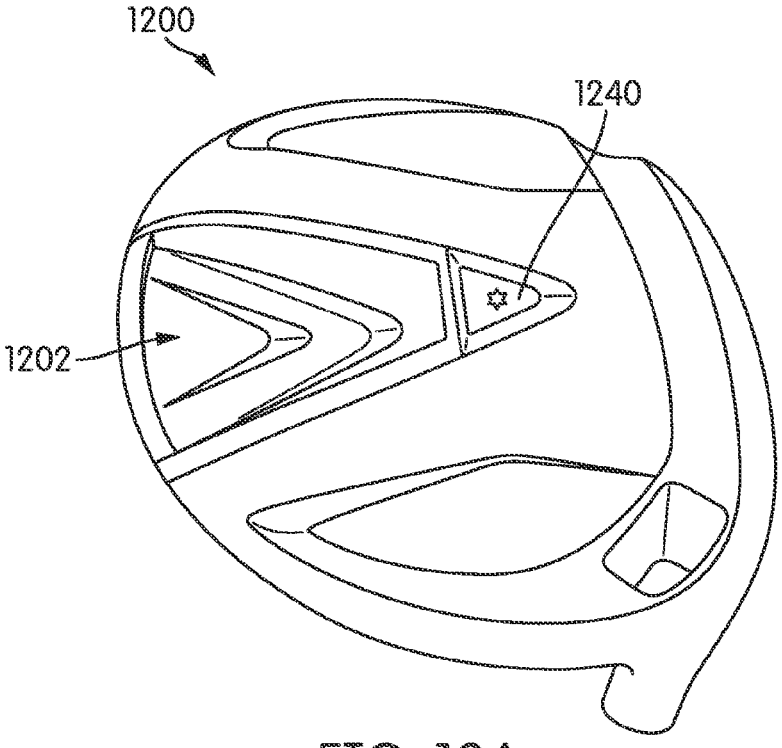


FIG. 12A

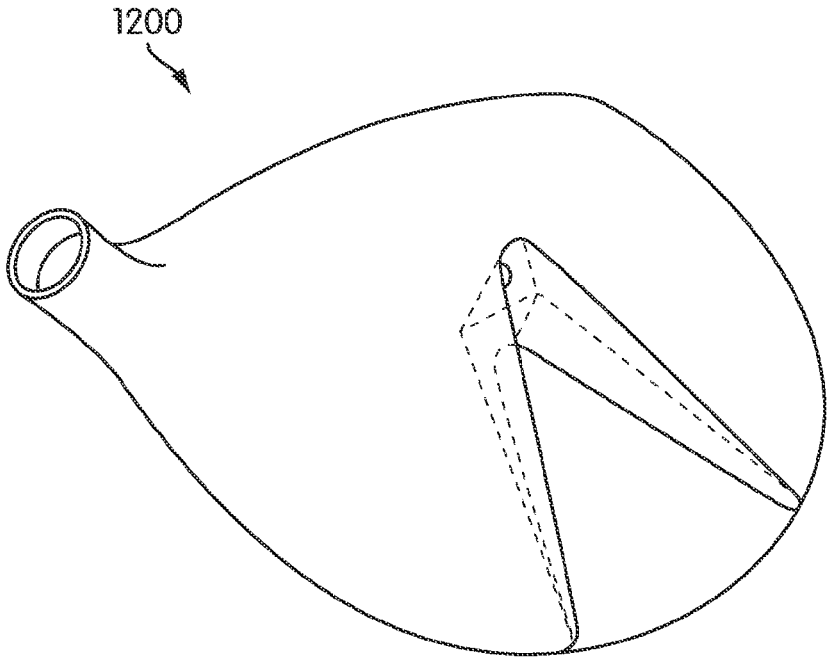


FIG. 12B

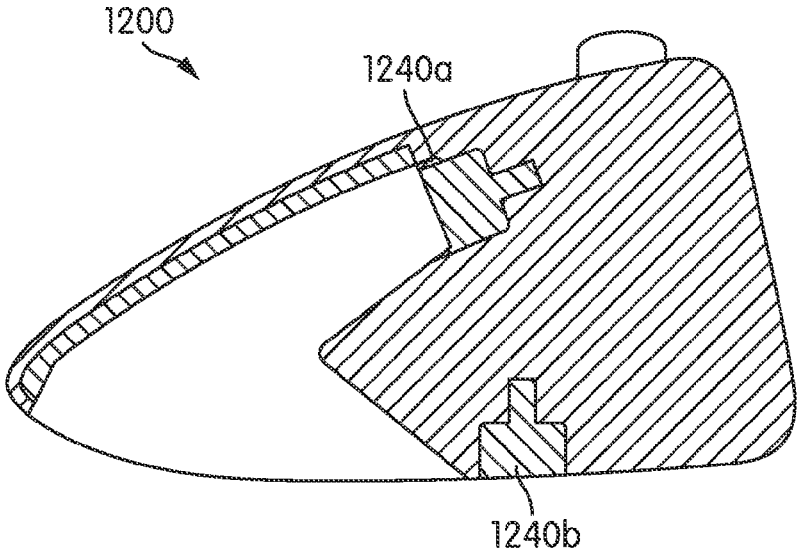


FIG. 12C

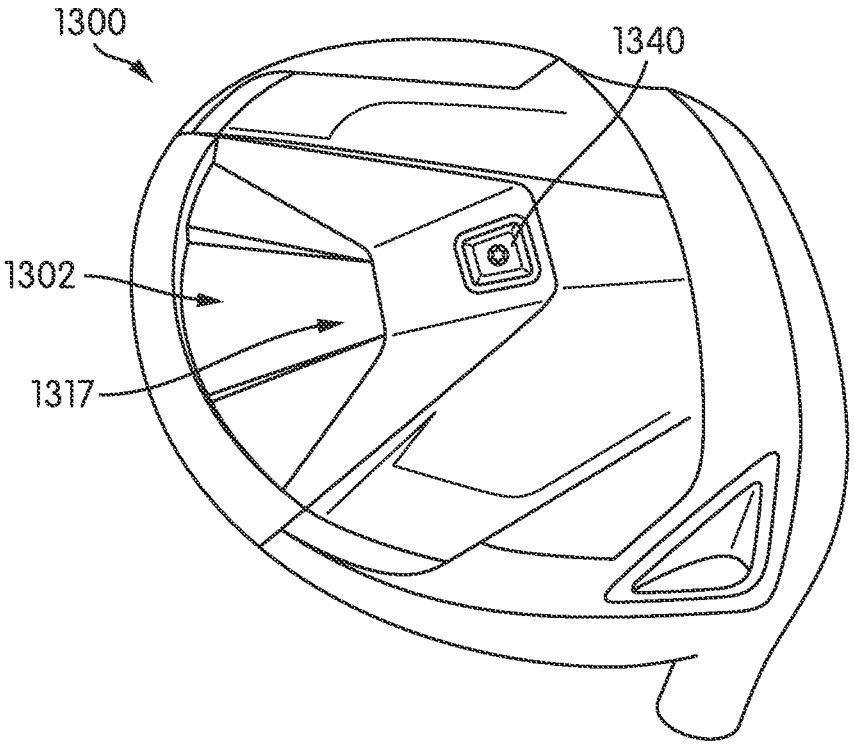


FIG. 13A

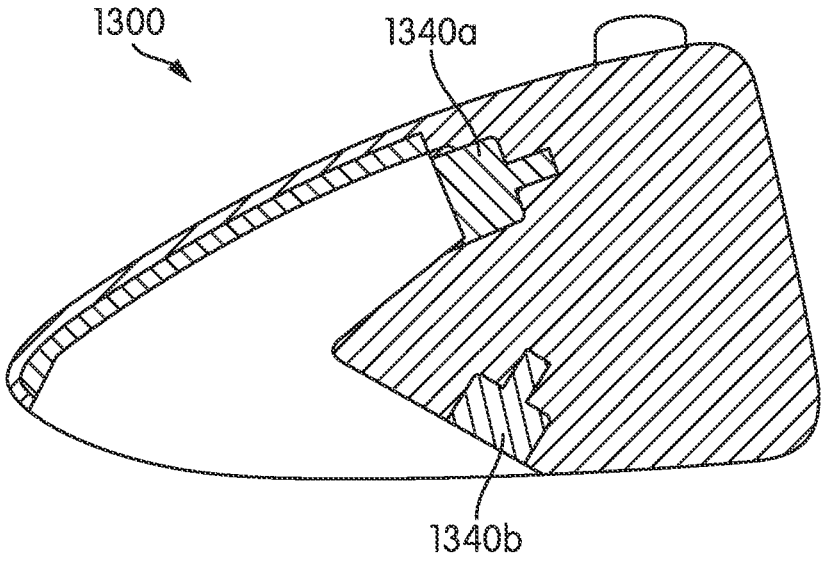


FIG. 13B

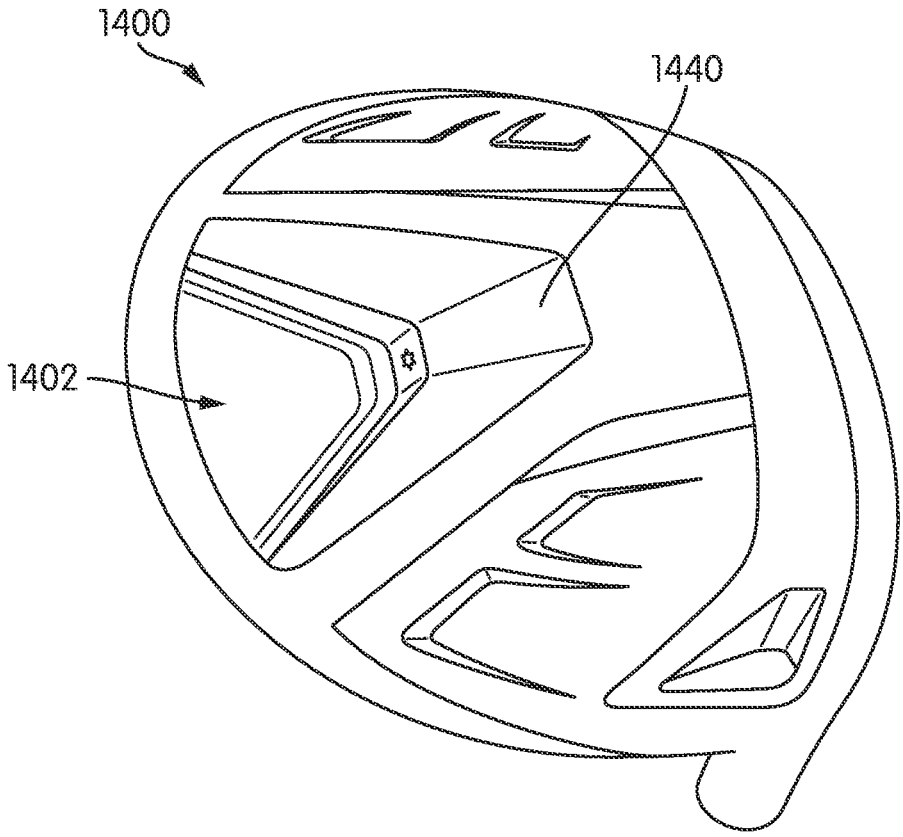


FIG. 14A

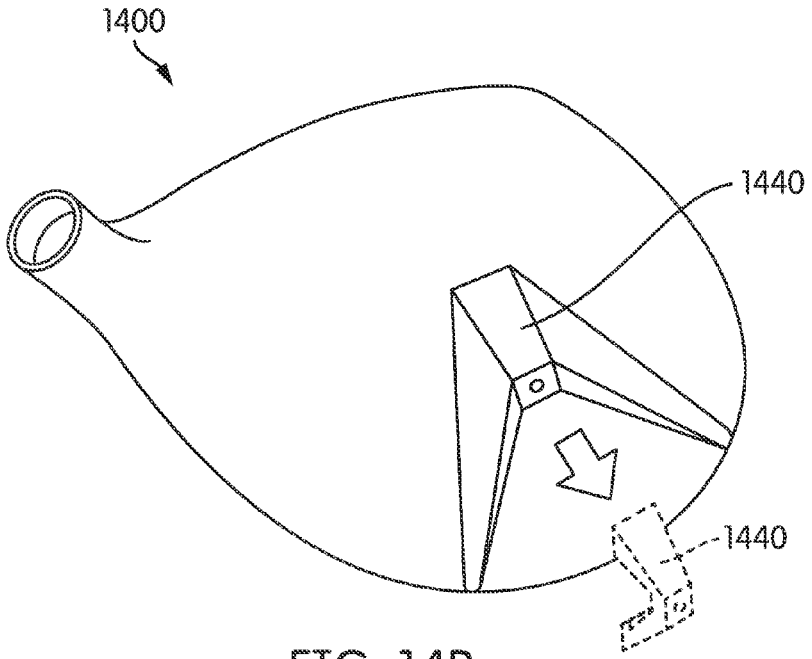


FIG. 14B

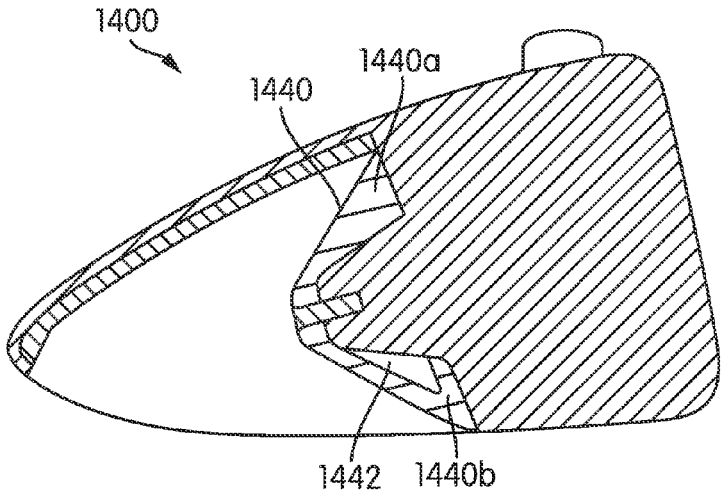


FIG. 14C

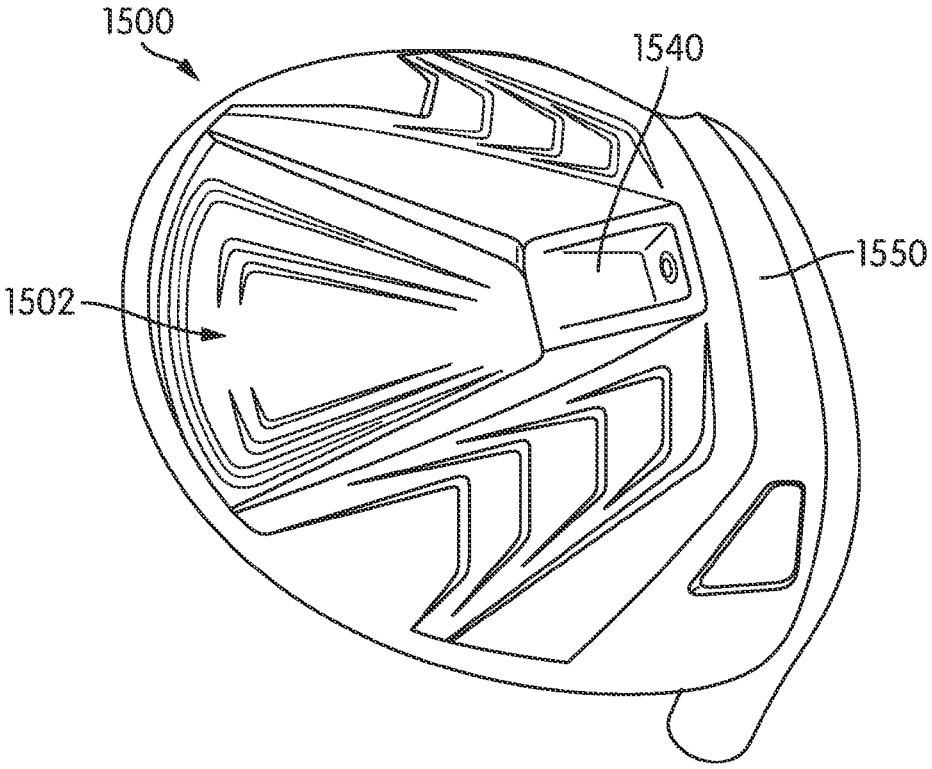


FIG. 15A

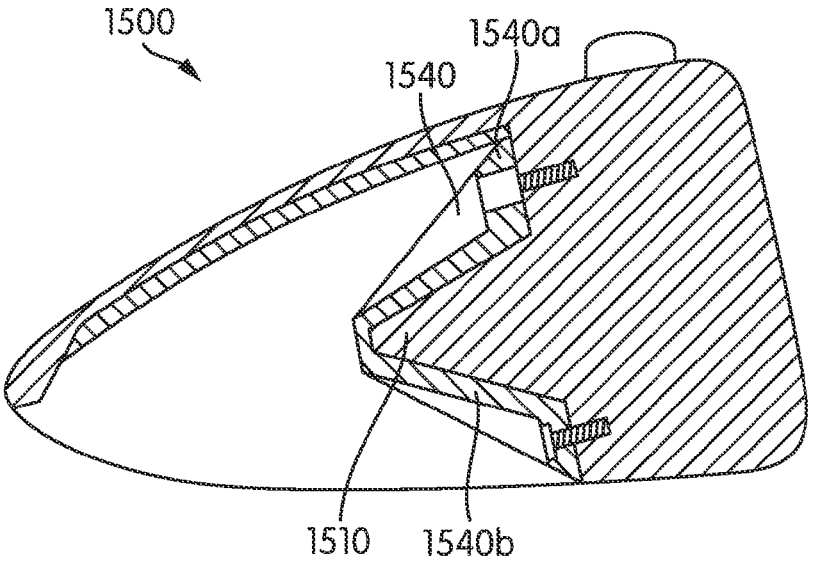
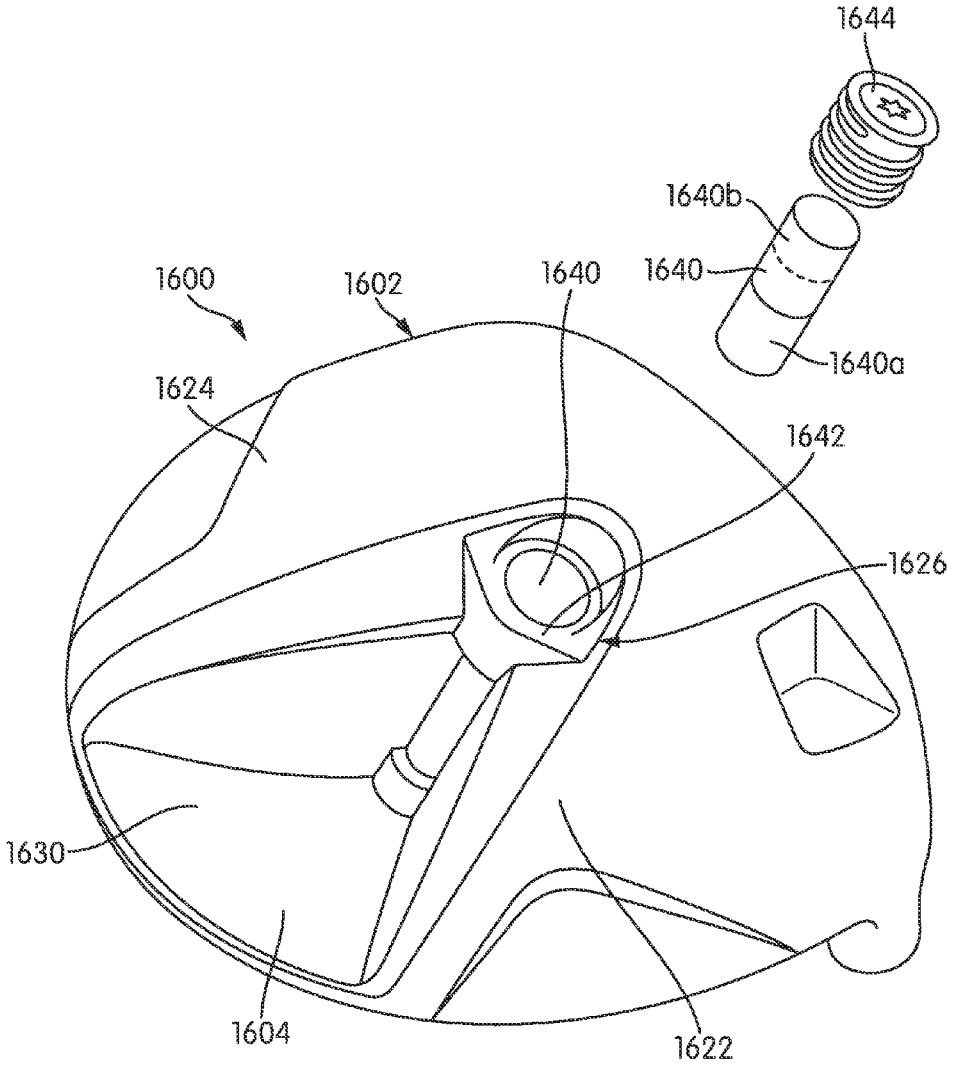


FIG. 15B


1644
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1600
1602
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1640a
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1642
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1604
1622

FIG. 16

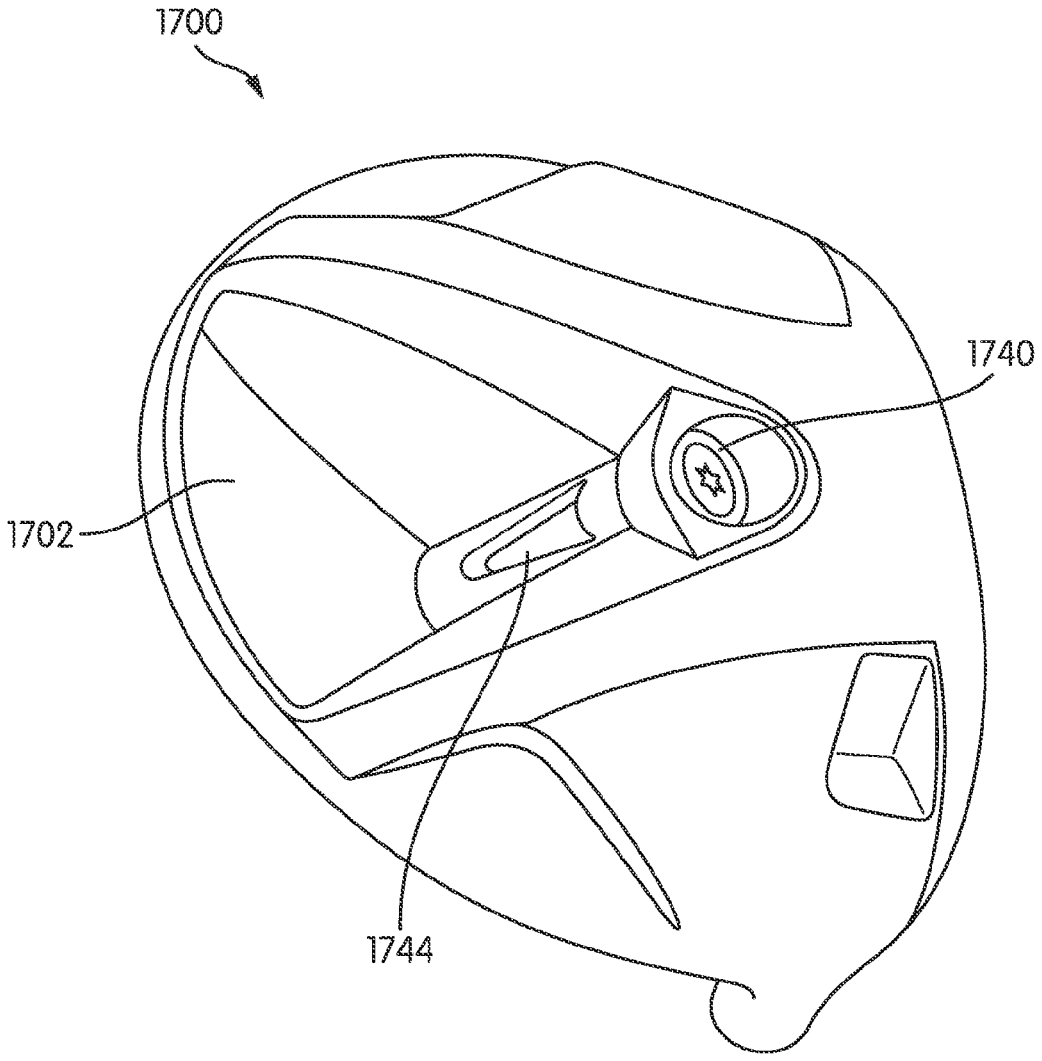


FIG. 17A

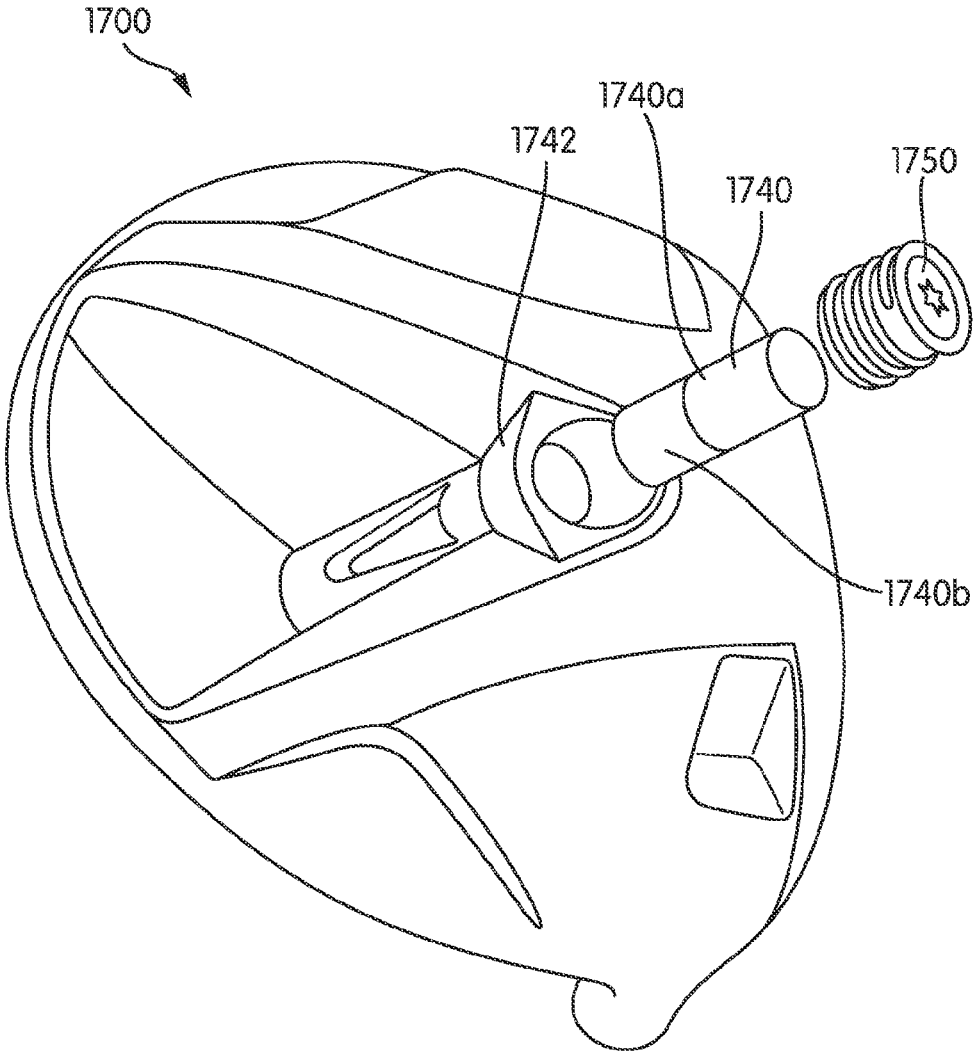


FIG. 17B

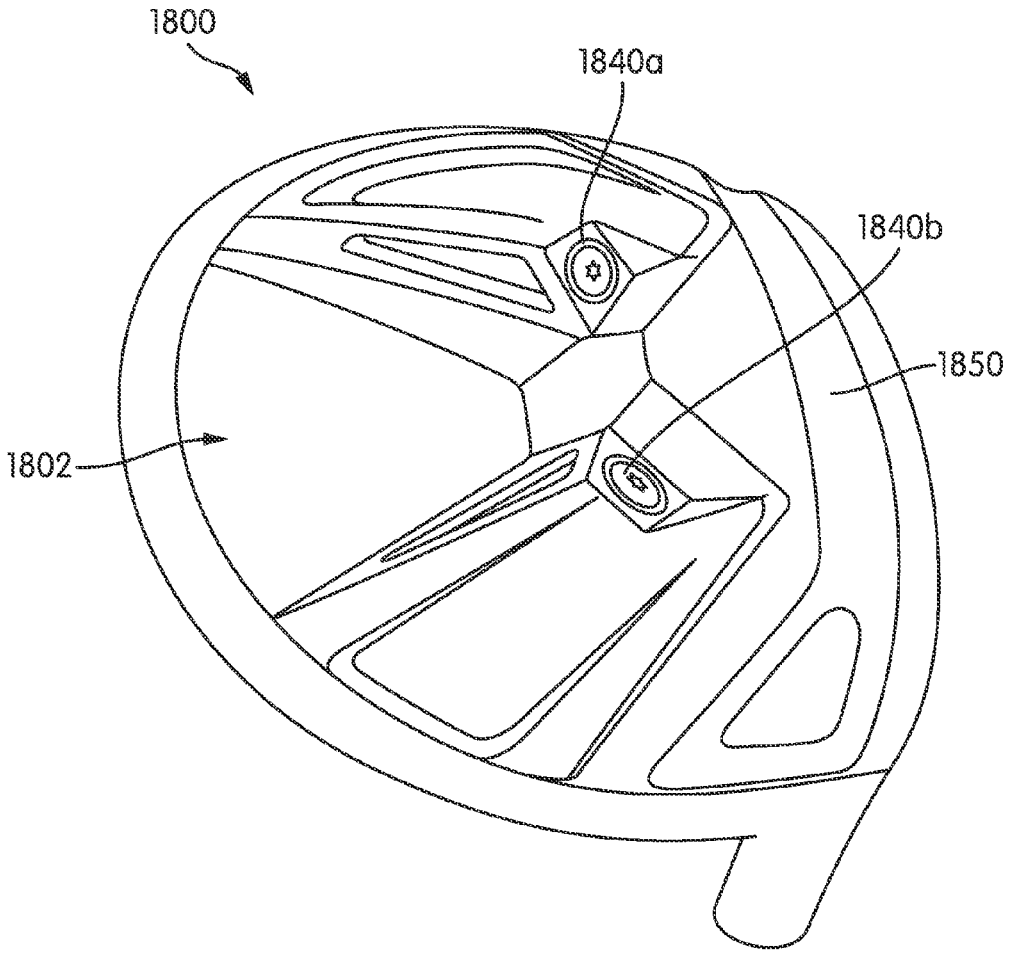


FIG. 18

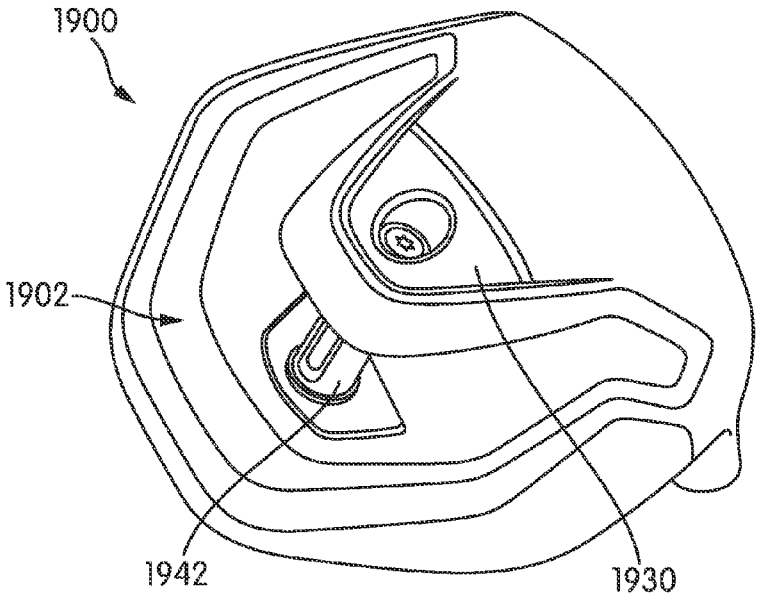


FIG. 19A

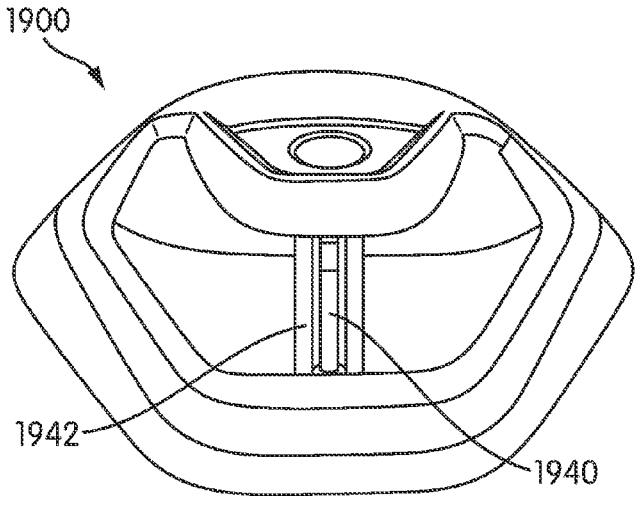


FIG. 19B

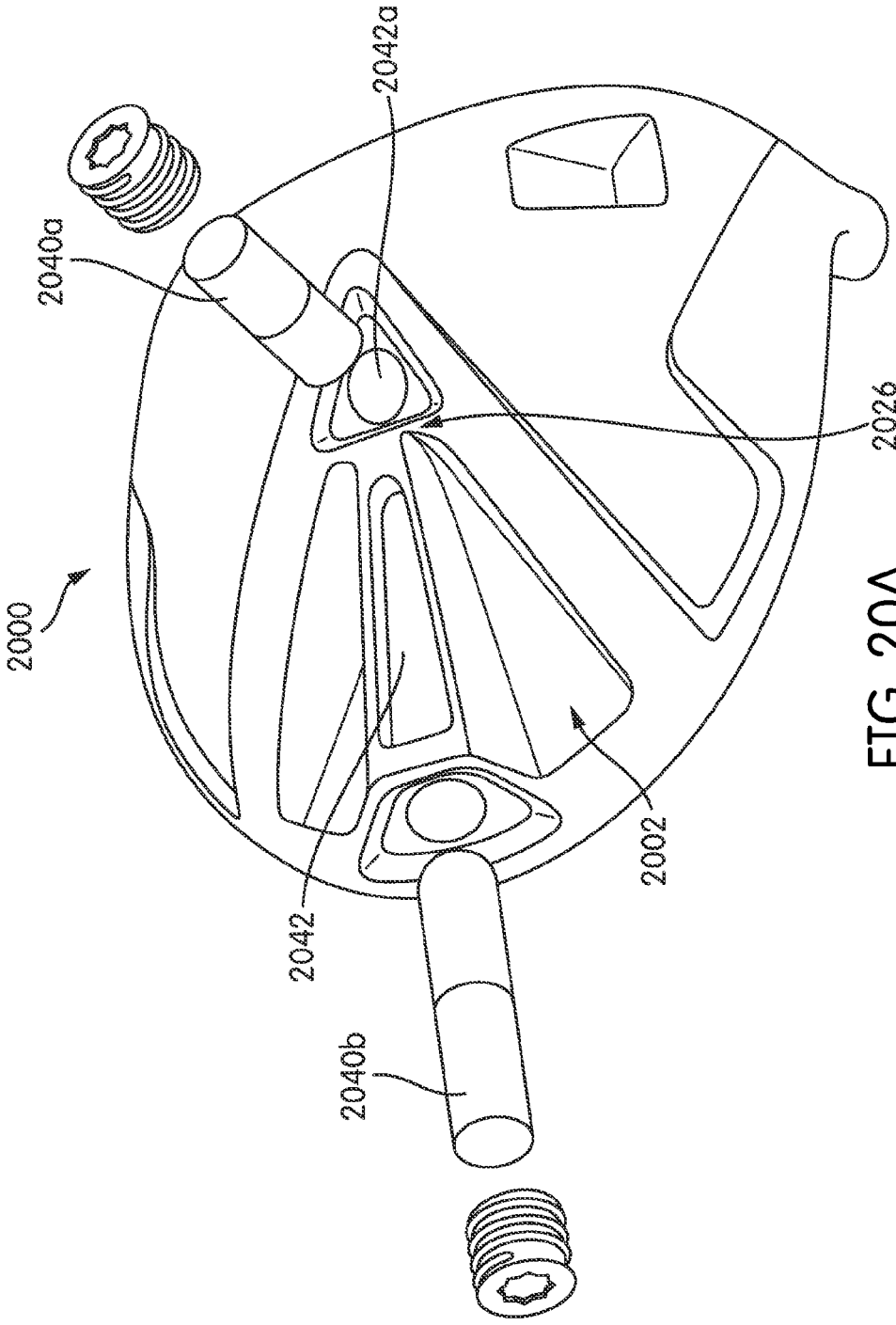


FIG. 20A

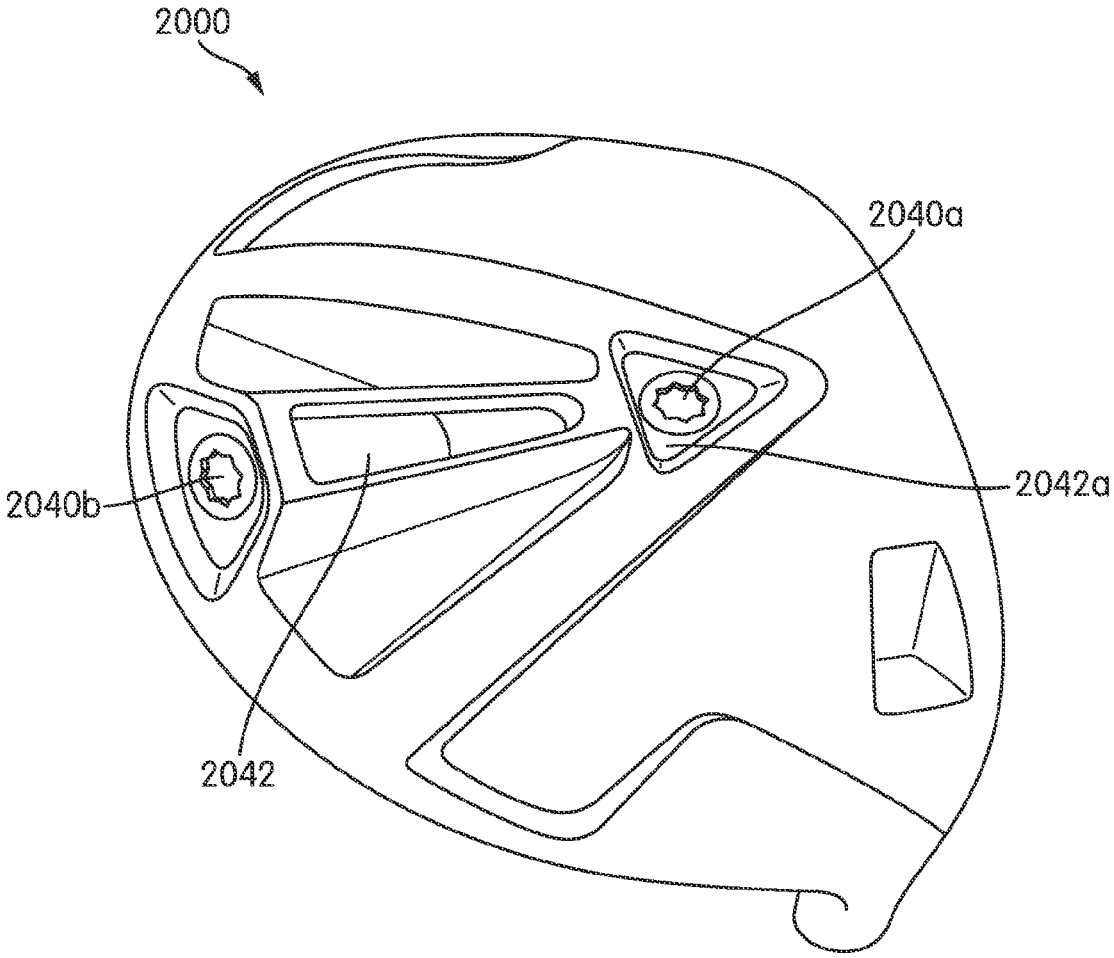
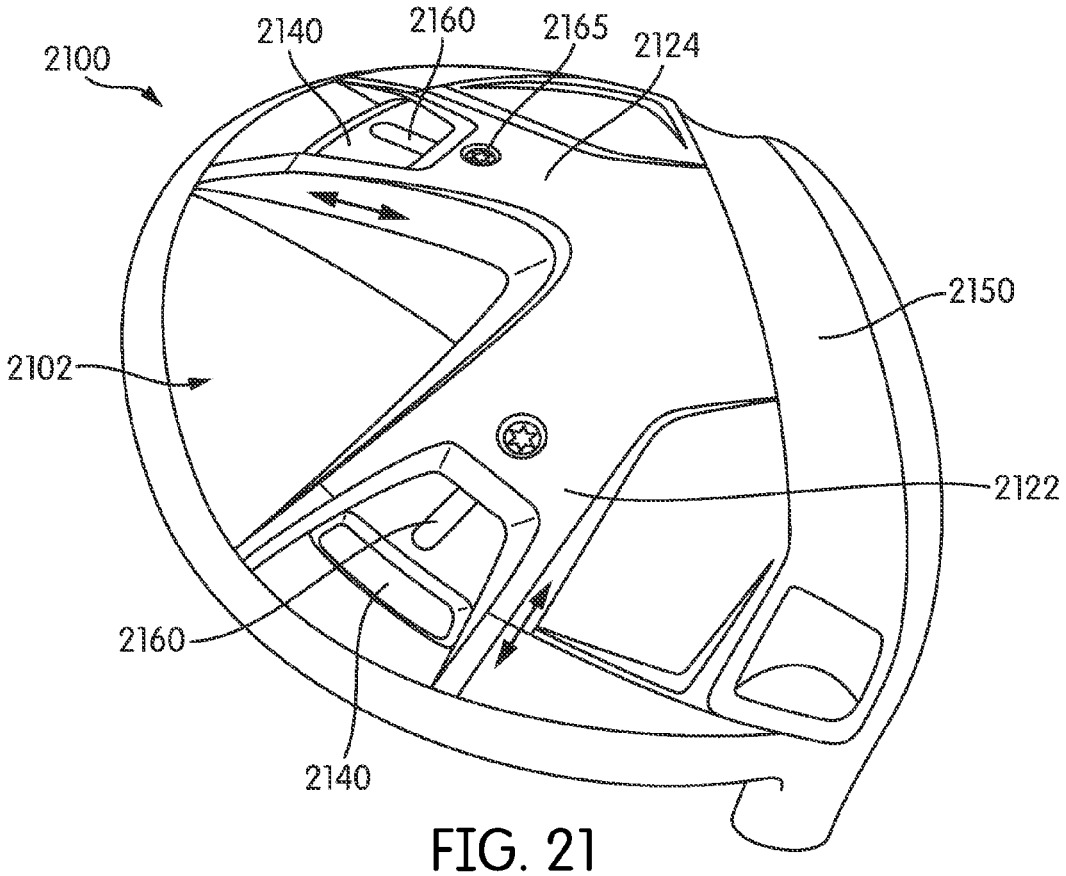


FIG. 20B


2100
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2102
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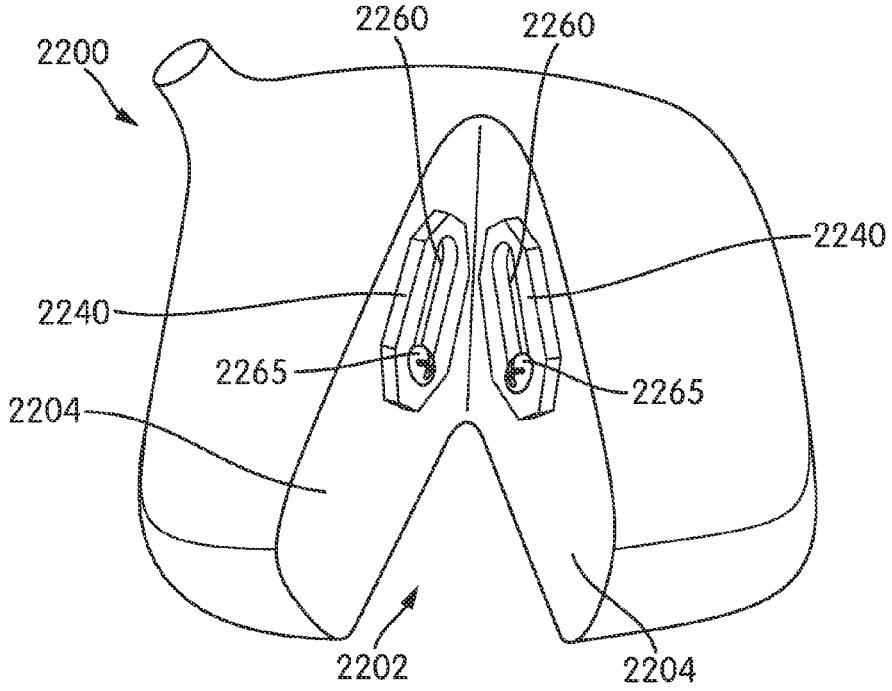
2160
2140

FIG. 21


2200
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2260
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2240
2265
2265
2204
2202
2204

FIG. 22

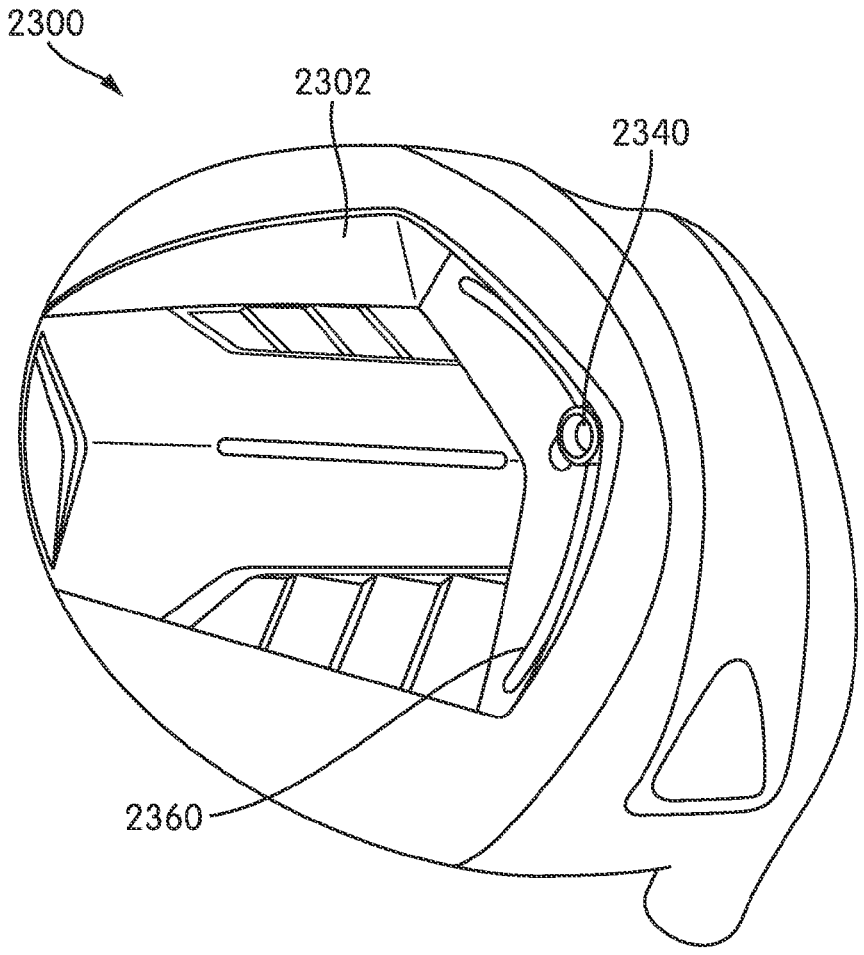


FIG. 23A

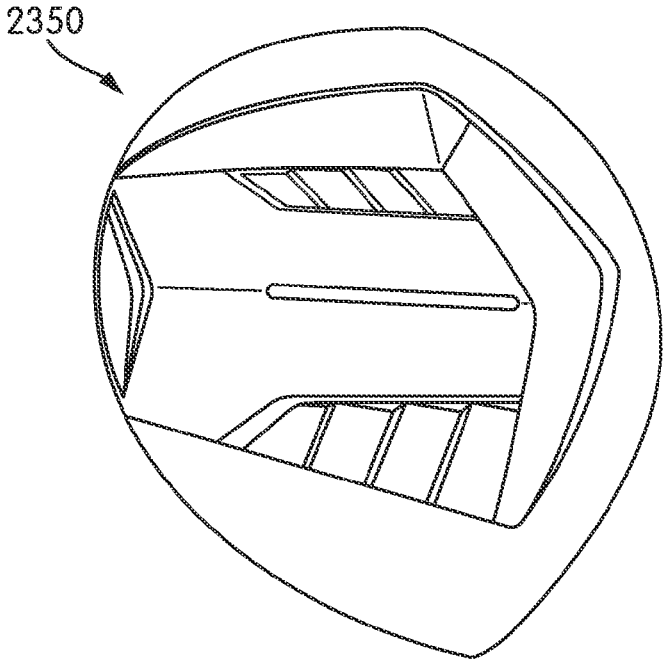


FIG. 23B

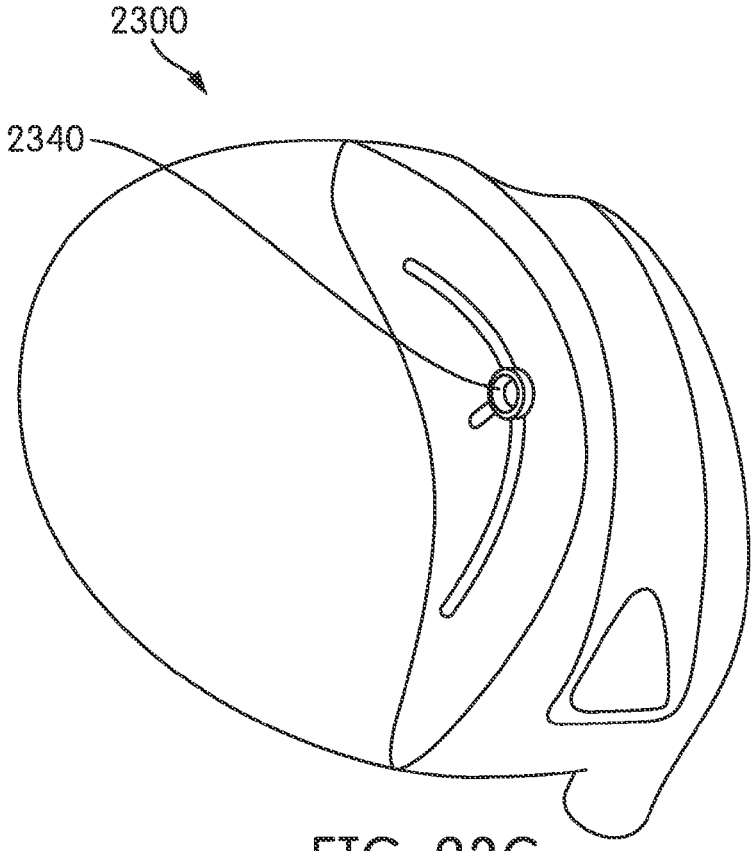


FIG. 23C

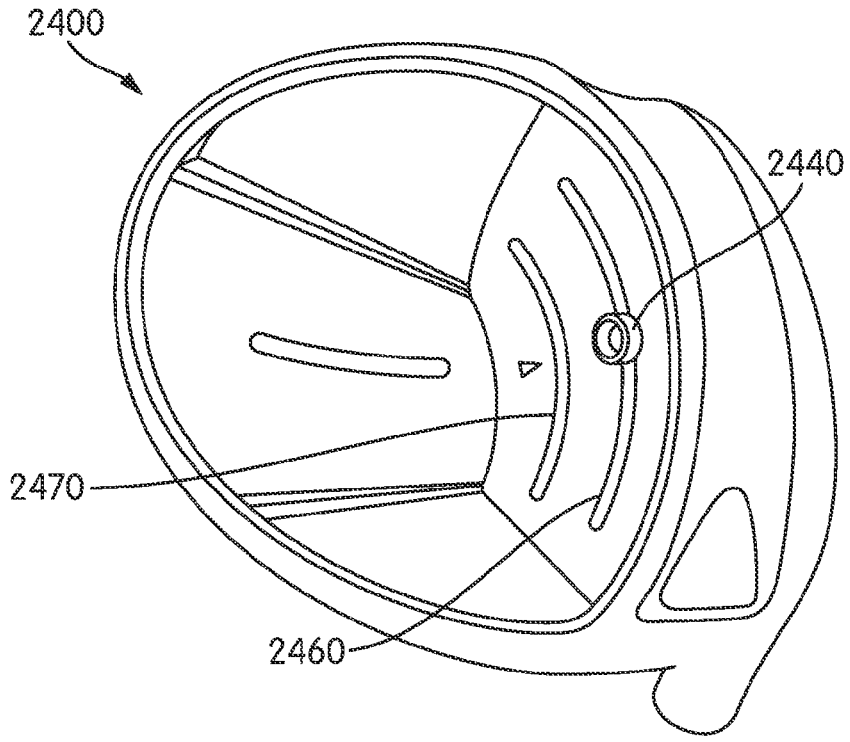


FIG. 24A

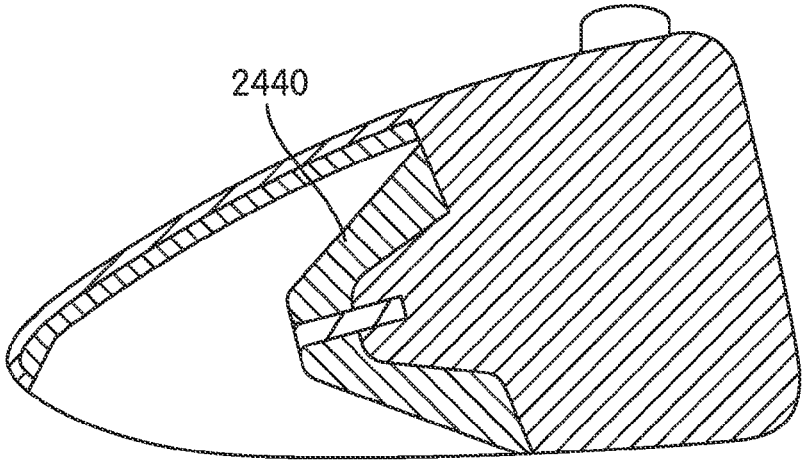


FIG. 24B

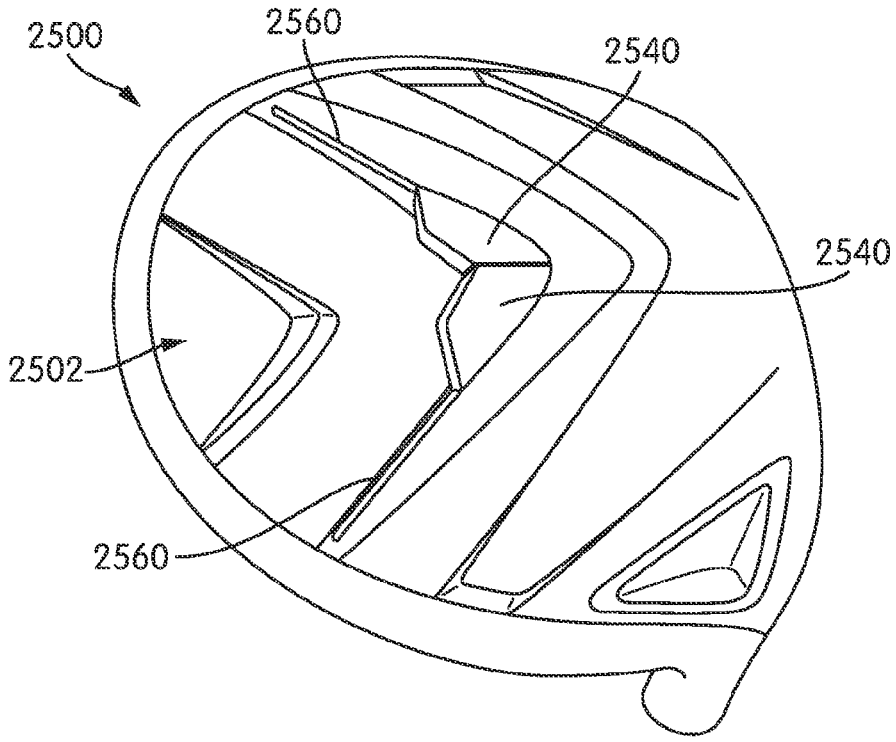


FIG. 25A

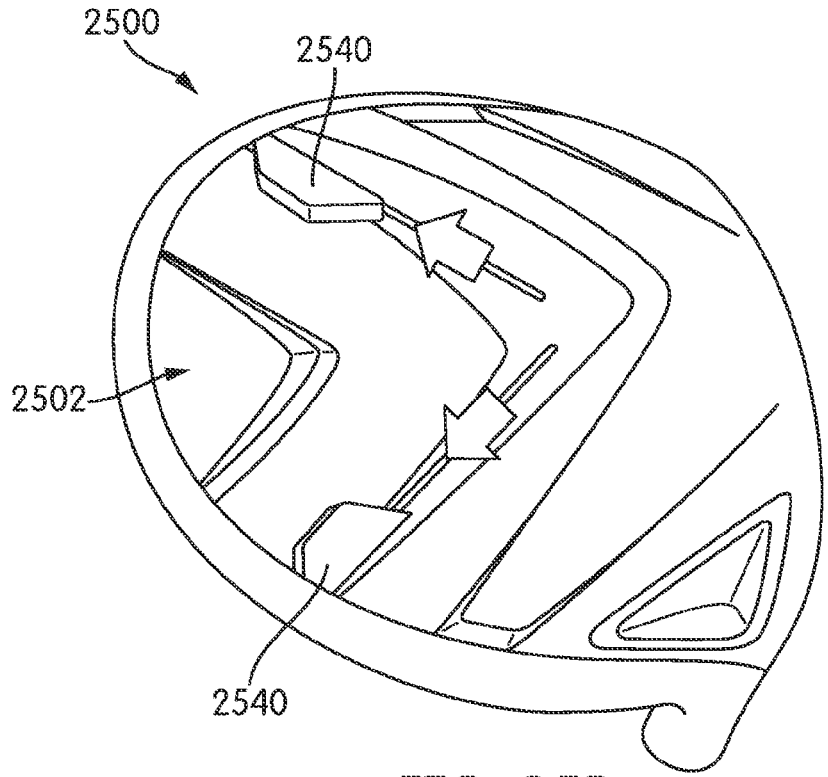


FIG. 25B

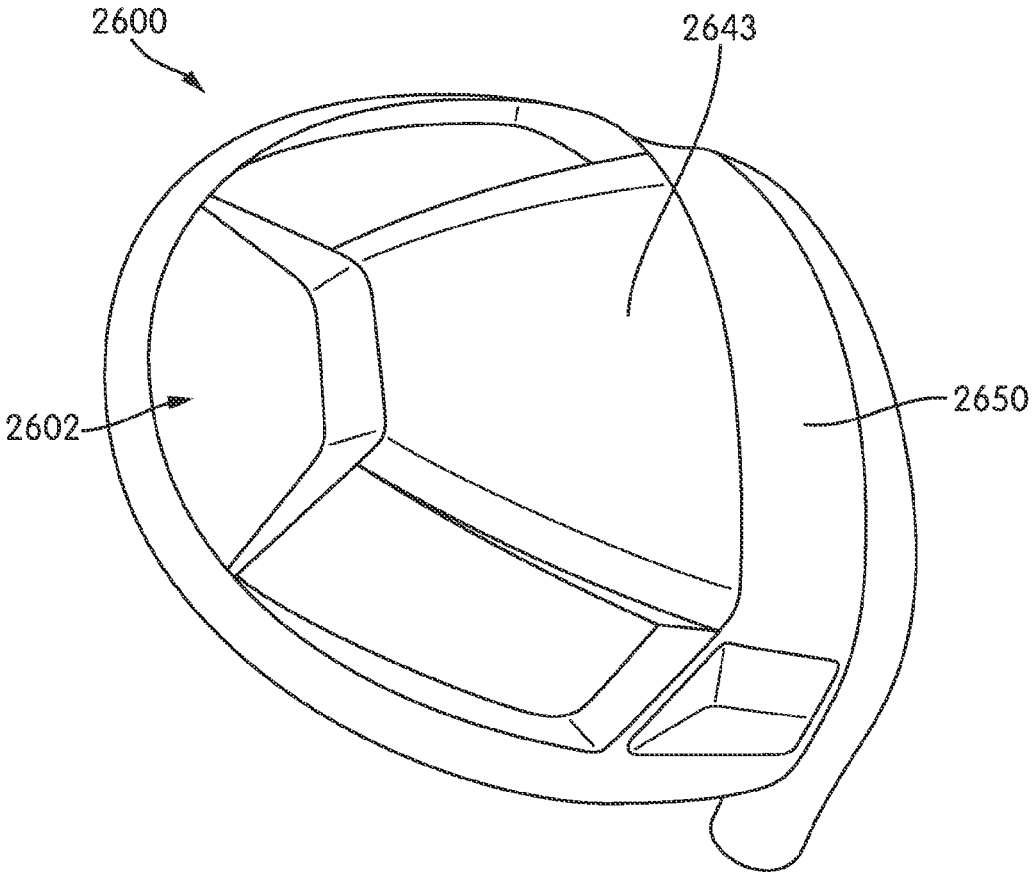


FIG. 26

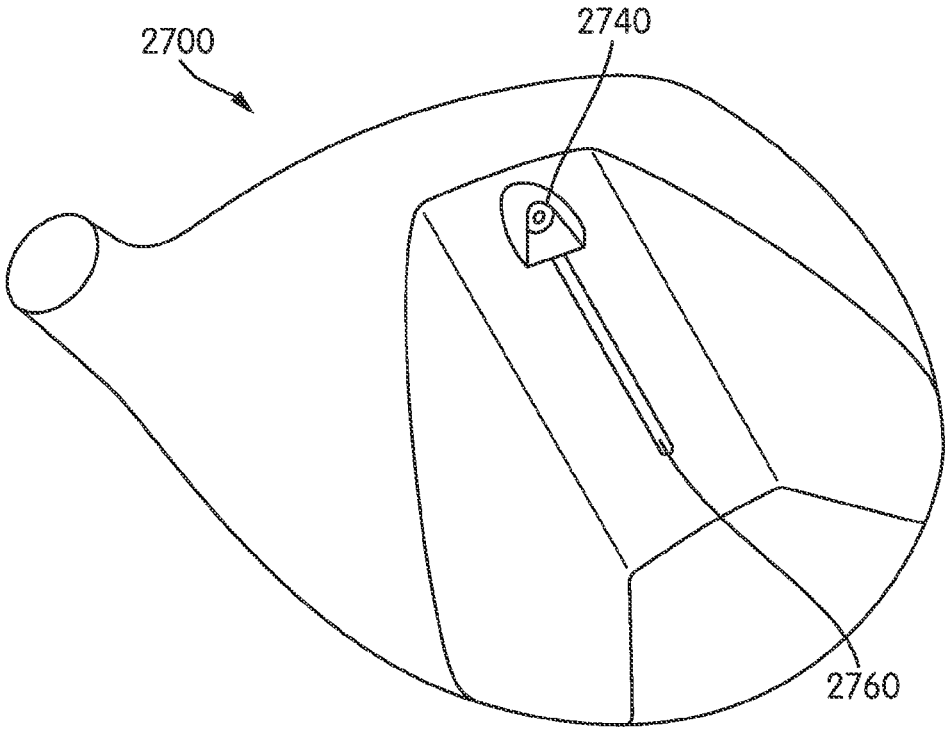


FIG. 27A

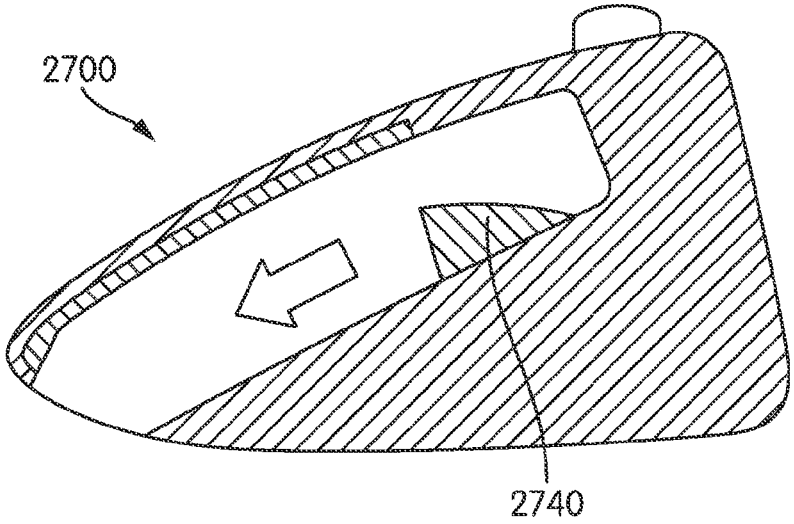


FIG. 27B

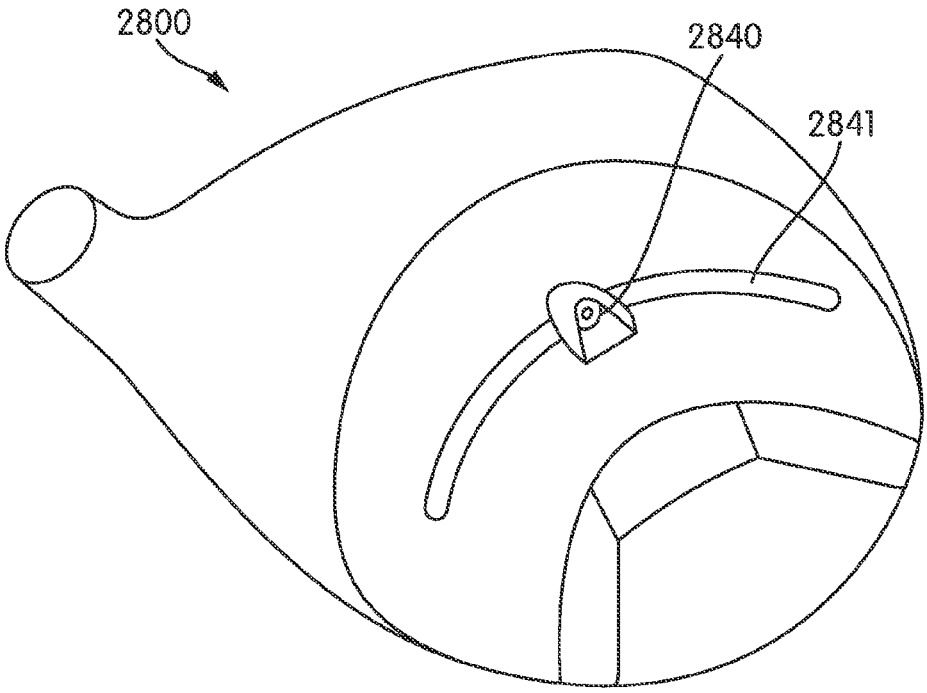


FIG. 28

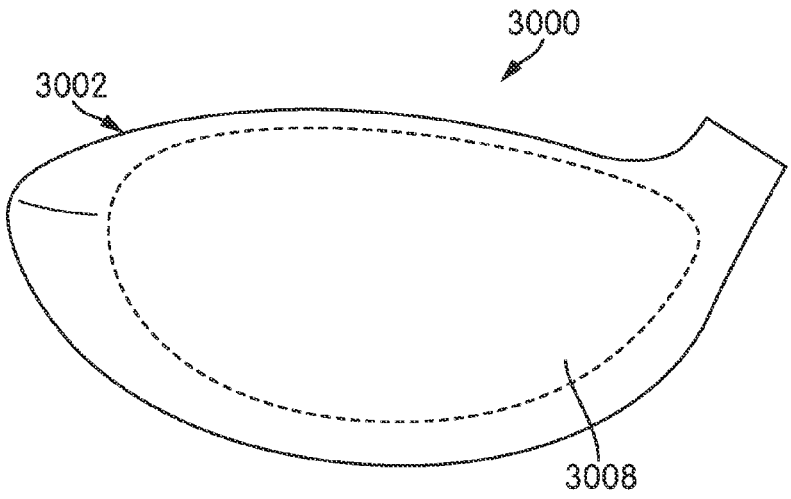


FIG. 29

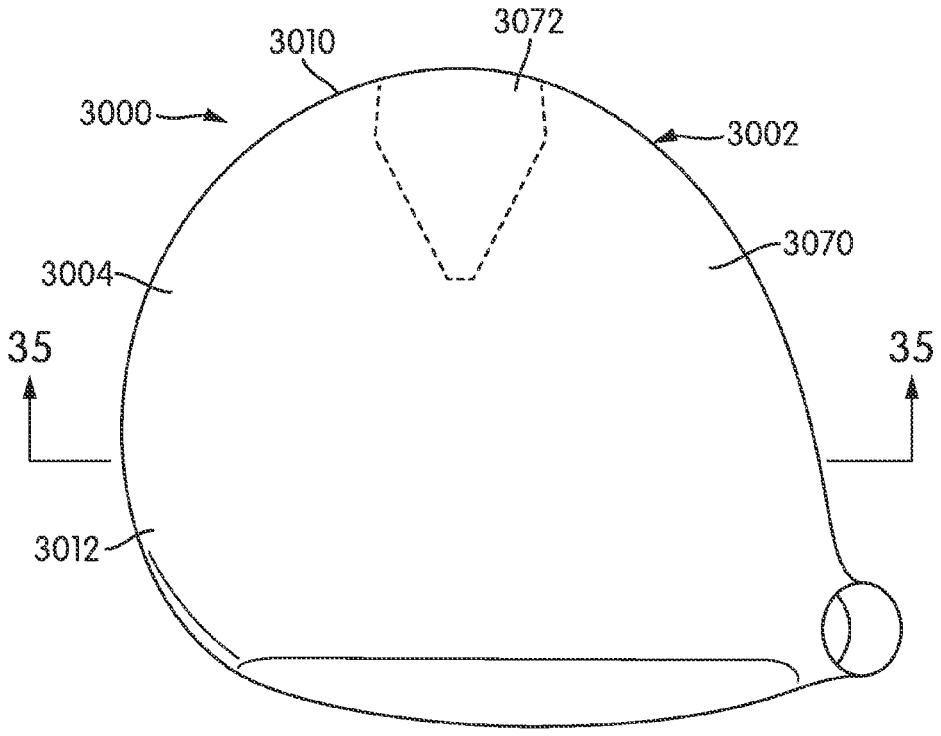


FIG. 30

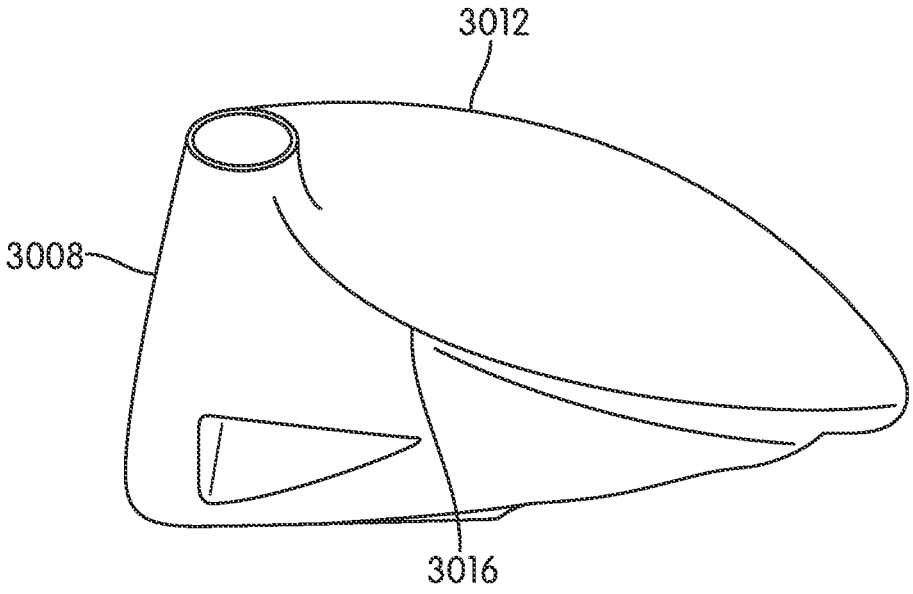


FIG. 31

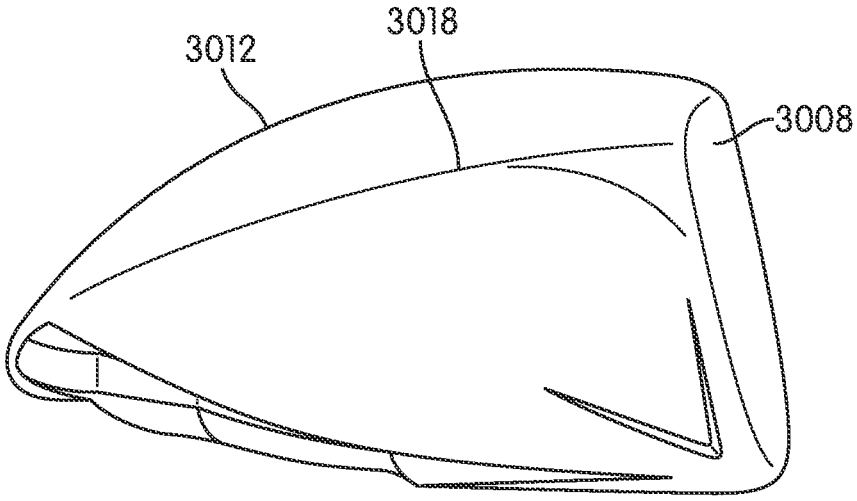
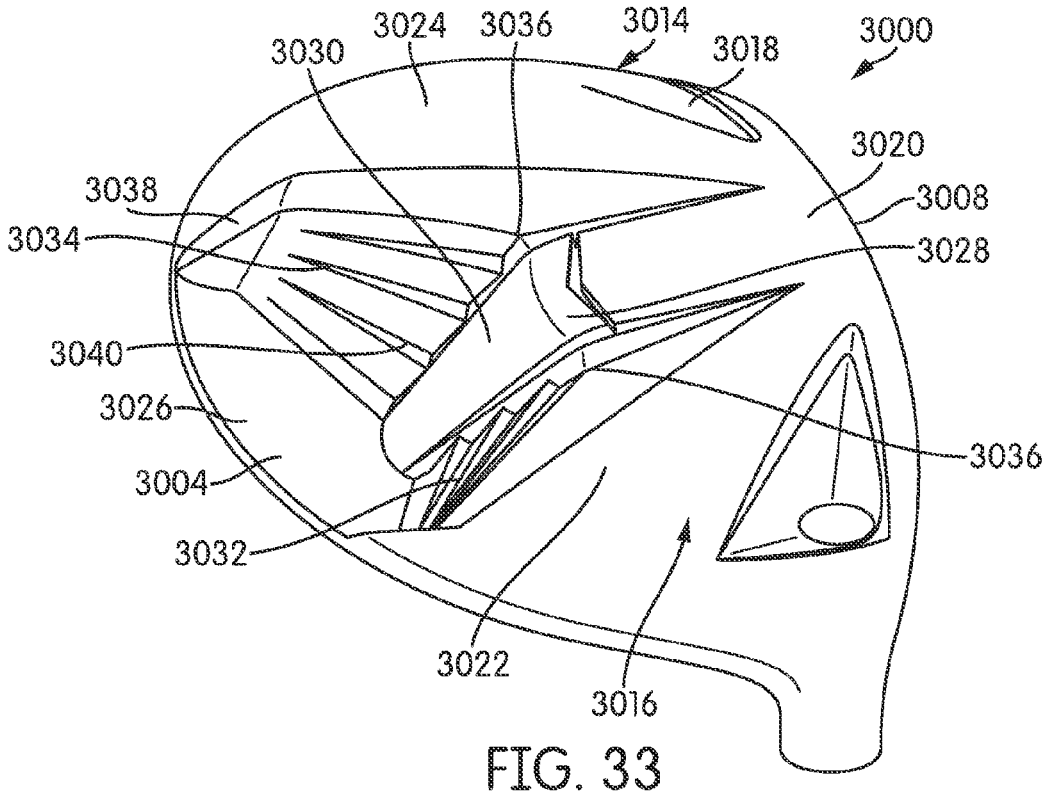


FIG. 32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3008
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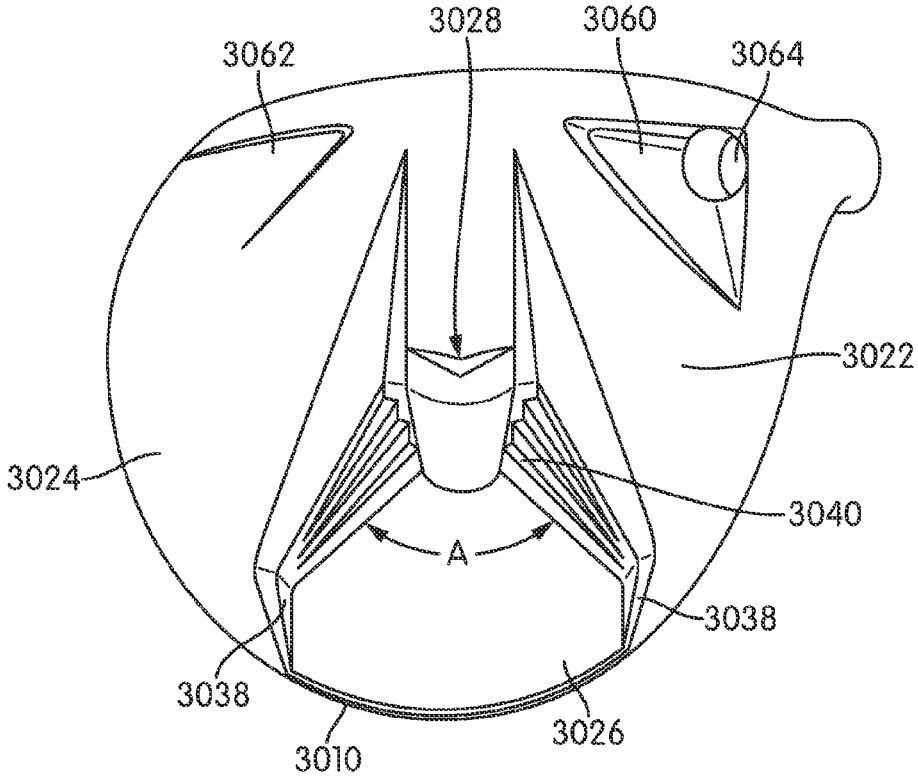
FIG. 33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A
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FIG. 34

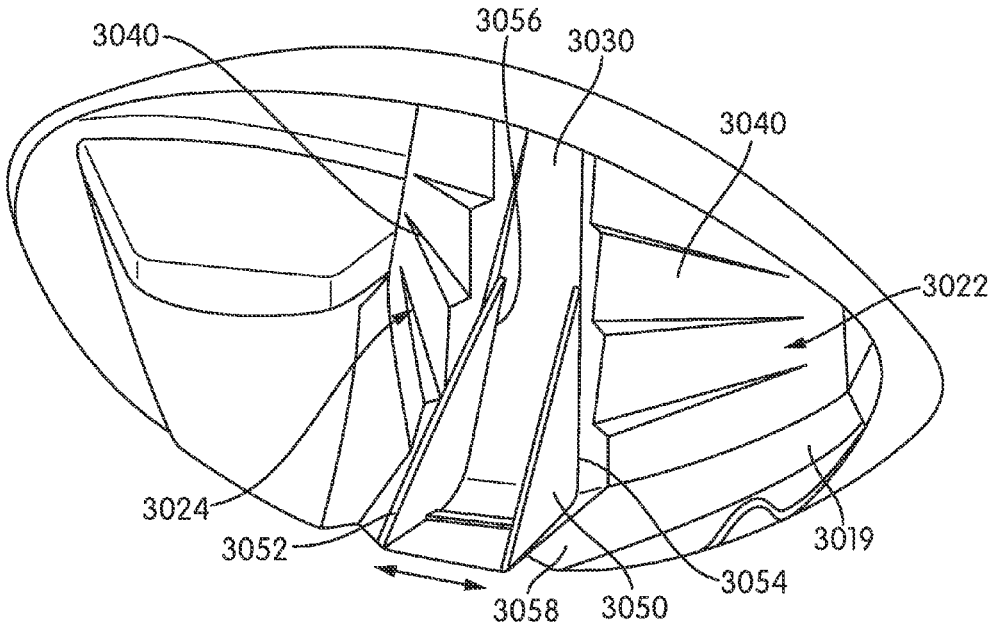

FIG. 35

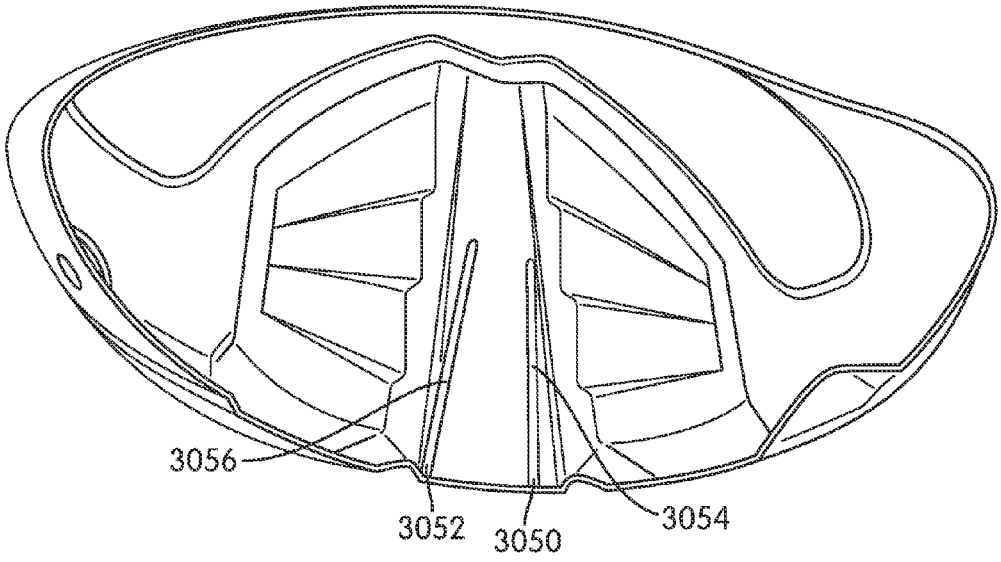

FIG. 35A

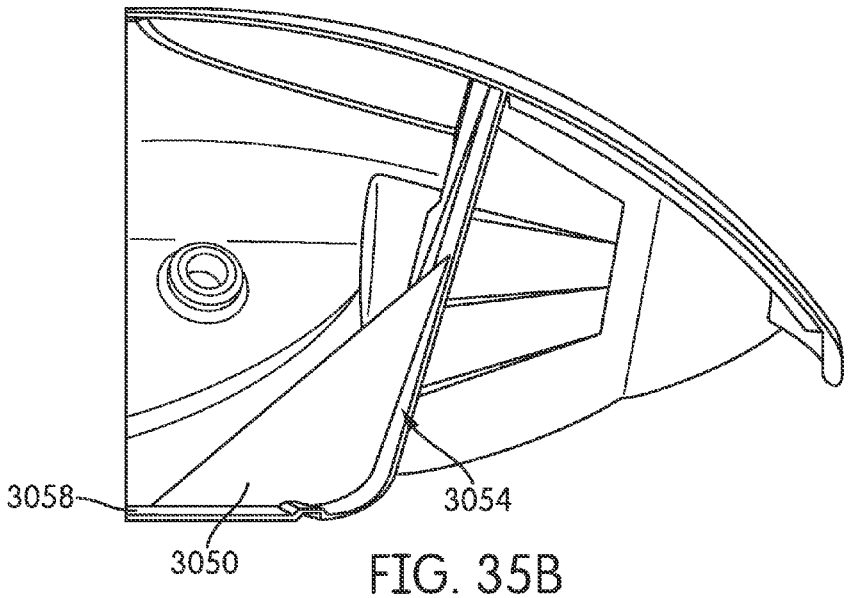

FIG. 35B

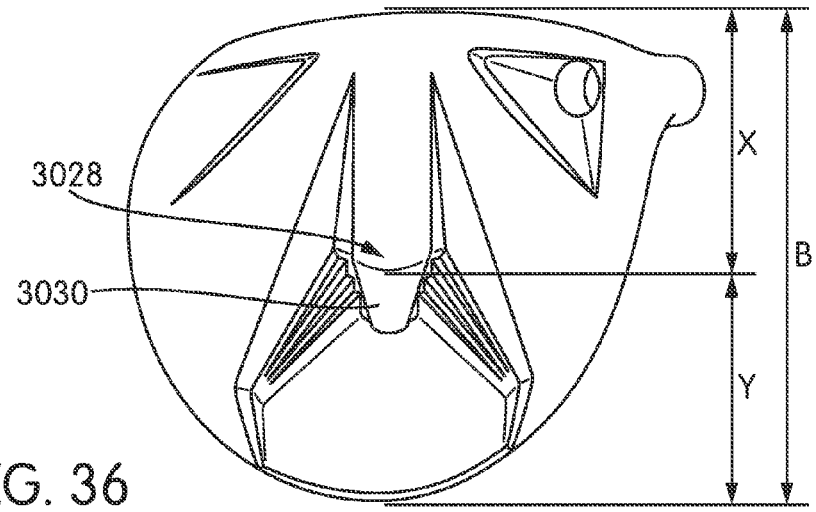

FIG. 36

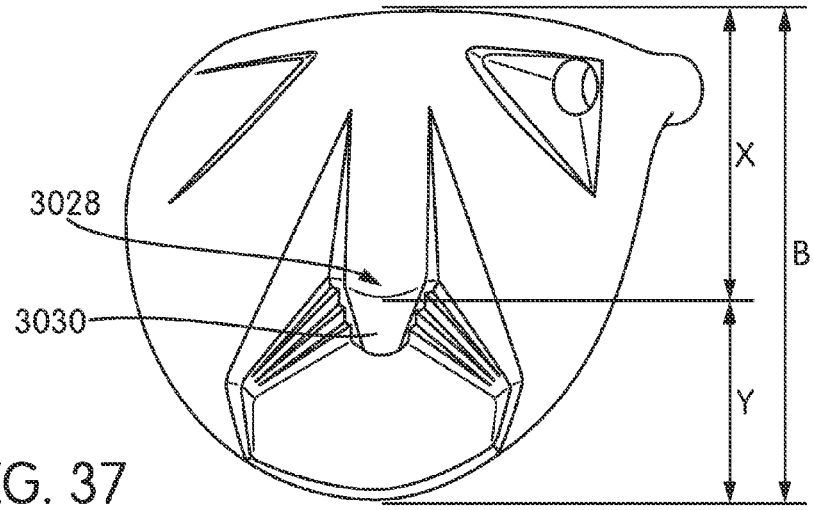

FIG. 37

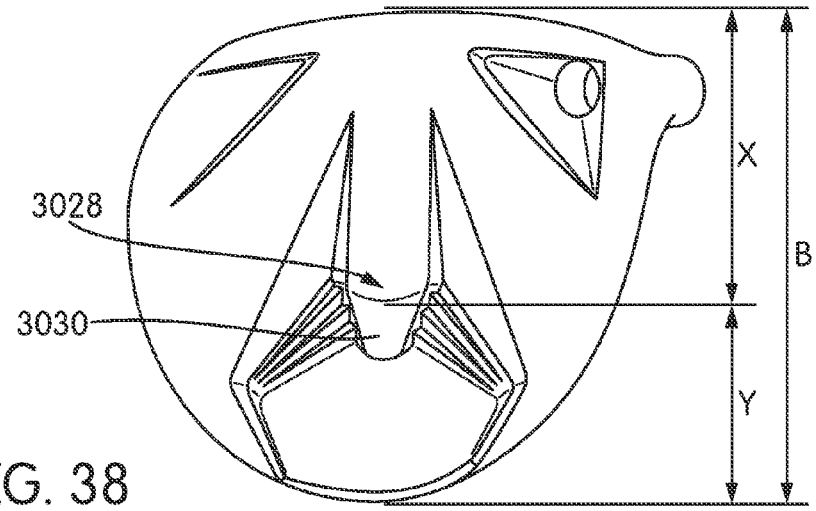

FIG. 38

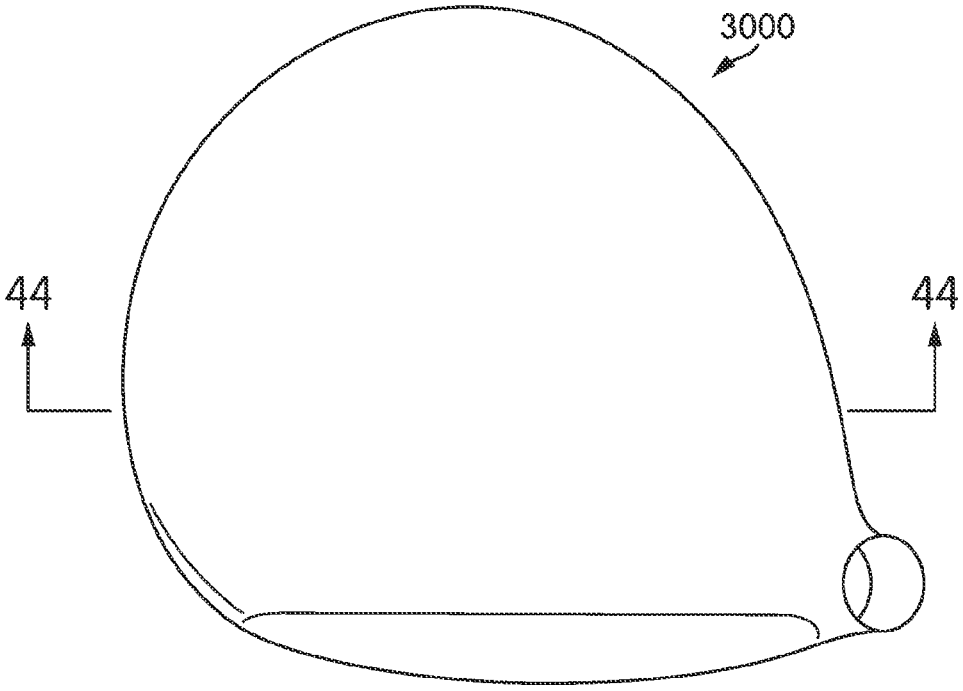

FIG. 39

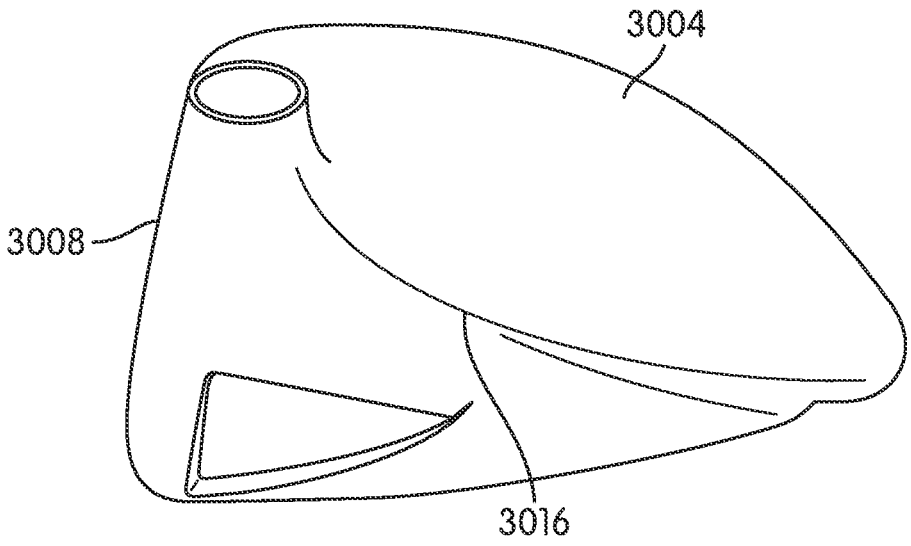

FIG. 40

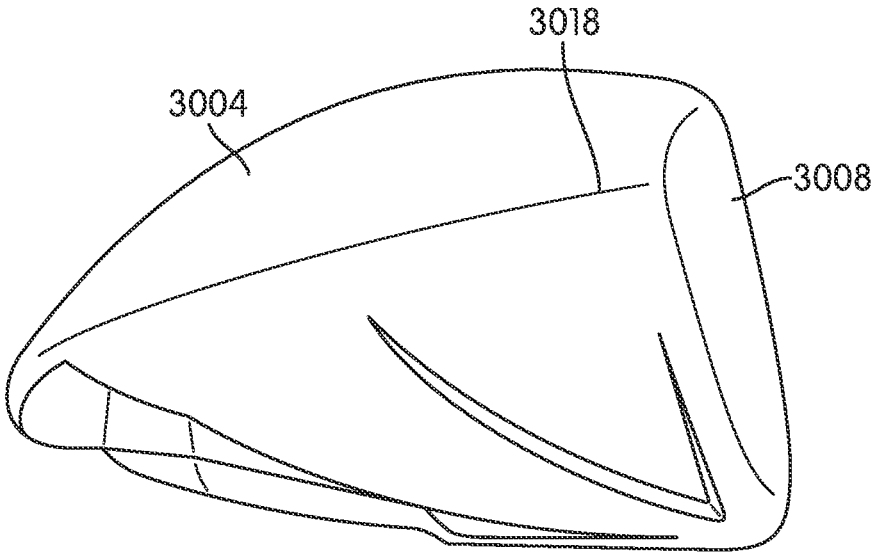

FIG. 41

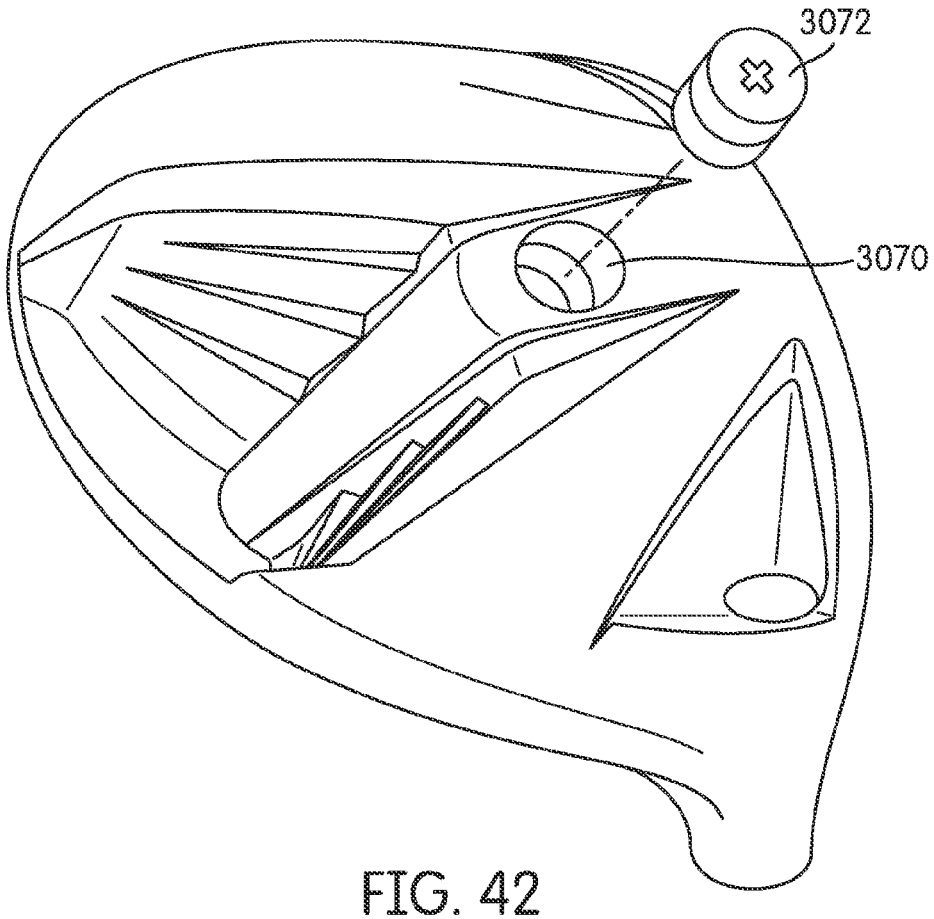

FIG. 42

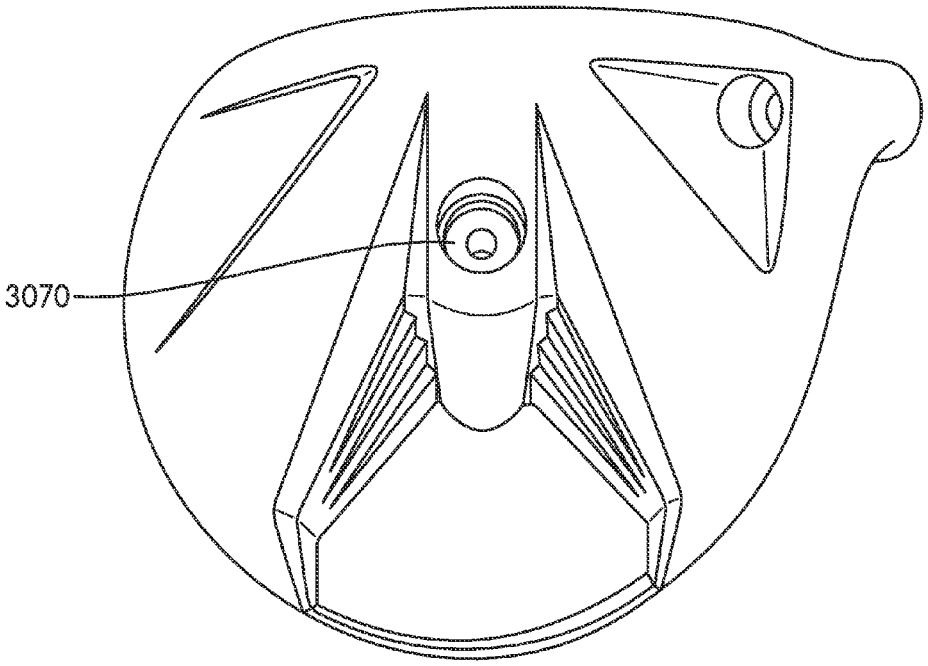

FIG. 43

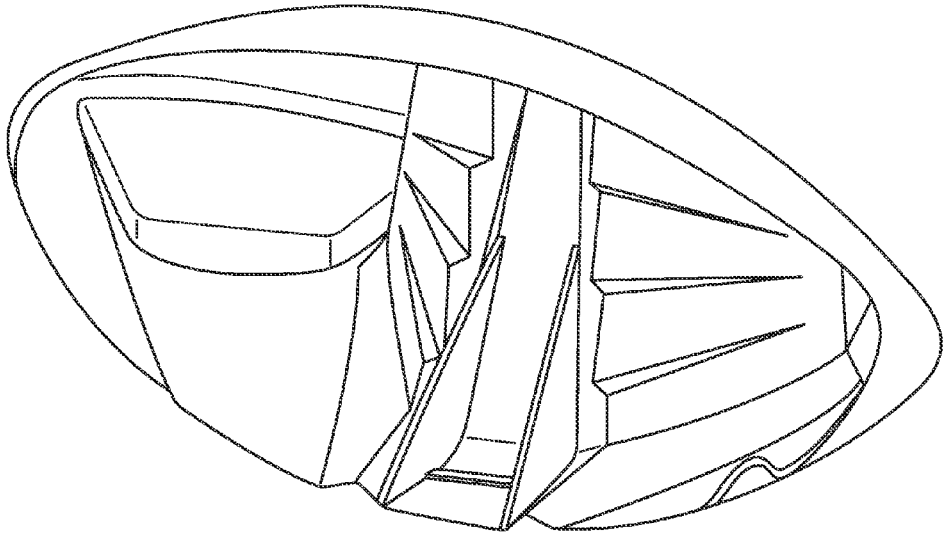

FIG. 44

GOLF CLUB AND GOLF CLUB HEAD STRUCTURES

RELATED APPLICATIONS

The present application claims the benefit of and is a non-provisional of U.S. Patent Application No. 61/526,326, filed on Aug. 23, 2011, and U.S. Patent Application No. 61/598,832, filed on Feb. 14, 2012, and the present application further claims priority to and is a continuation-in part of U.S. patent application Ser. No. 13/250,051, filed on Sep. 30, 2011, which claims priority to and is a non-provisional of U.S. Patent Application No. 61/480,322, filed Apr. 28, 2011, and this application also claims priority to and is a continuation-in-part of U.S. patent application Ser. No. 12/723,951, filed on Mar. 15, 2010, which claims priority to and is a continuation-in-part of U.S. patent application Ser. No. 12/356,176, filed on Jan. 20, 2009, now U.S. Pat. No. 7,922,603, which applications are incorporated by reference herein and made a part hereof.

TECHNICAL FIELD

Aspects of this invention relate generally to golf clubs and golf club heads, and, in particular, to golf clubs and golf club heads having a portion of the club head removed or open, thereby creating a void in the club head, in order to reduce or redistribute weight associated with the club head to enhance performance.

BACKGROUND

Golf is enjoyed by a wide variety of players, players of different genders and players of dramatically different ages and/or skill levels. Golf club designers have successfully advanced the technology incorporated in golf clubs in response to the constant demand of golfers for improved performance. In one aspect, golfers tend to be sensitive to the "feel" of a golf club. The "feel" of a golf club comprises the combination of various component parts of the club and various features associated with the club that produce the sensations experienced by the player when a ball is swung at and/or struck. Club weight, weight distribution, swing weight, aerodynamics, swing speed, and the like all may affect the "feel" of the club as it swings and strikes a ball. "Feel" also has been found to be related to the sound produced when a club head strikes a ball to send the ball in motion. If a club head makes an unpleasant, undesirable, or surprising sound at impact, a user may flinch, give up on his/her swing, decelerate the swing, lose his/her grip, and/or not completely follow-through on the swing, thereby affecting distance, direction, and/or other performance aspects of the swing and the resulting ball motion. User anticipation of this unpleasant, undesirable, or surprising sound can affect a swing even before the ball is hit.

Also, the performance of a golf club can vary based on several factors, including weight distribution about the club head, which affects the location of the center of gravity of the golf club head. When the center of gravity is positioned behind the point of engagement on the contact surface, the golf ball follows a generally straight route. When the center of gravity is spaced to a side of the point of engagement, however, the golf ball may fly in an unintended direction and/or may follow a route that curves left or right, including ball flights that often are referred to as "pulls," "pushes," "draws," "fades," "hooks," or "slices." Similarly, when the center of gravity is spaced above or below the point of engagement, the flight of the golf ball may exhibit more boring or climbing trajectories, respectively.

Weight distribution about the club head can also affect moment of inertia associated with the club head. Thus, altering the moment of inertia can affect how the golf club performs including how the golf club head design impacts heel and toe mishits. Similarly, other factors such as point of impact and launch angle can also affect how the ball travels once it has been struck.

Club designers are often looking for new ways to distribute or redistribute weight associated with a golf club and/or golf club head. For instance, club designers are often looking to distribute weight to provide more forgiveness in a club head, improved accuracy, a desired ball flight and the like. In pursuit of such designs, club designers also face a challenge of maintaining a club head having a traditional aesthetic look desired by most golfers. While certain golf club and golf club head designs according to the prior art provide a number of advantageous features, they nevertheless have certain limitations. Accordingly, it would be advantageous to provide a golf club and golf club head having a reduced weight characteristic and improved weight distribution throughout the club head to enhance club performance. The present invention is provided to overcome certain of the limitations and drawbacks of the prior art, and to provide new features not heretofore available.

SUMMARY

At least some aspects of the disclosure relate to golf clubs and golf club heads having enhanced weight distribution about the club head. In one aspect, the golf club utilizes a geometric weight feature in the form of a void formed in the golf club head. The golf club head may include a cover extending over the void such that the void may not be visible from a top of the golf club head at an address position. In some examples, the golf club head may include certain support structures that enhance performance characteristics of the golf club head. In some additional examples, the golf club head may further include one or more adjustable weight arrangements.

These and additional features and advantages disclosed here will be further understood from the following detailed disclosure of certain embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGS. **1**A and **1**B illustrate example golf club and golf club head structures according to one or more aspects described herein.

FIGS. **2**A-**2**C illustrate an example golf club head having a void formed in a rear of the golf club head body and a cover according to one or more aspects described herein.

FIGS. **3**A-**3**D illustrate example golf club head bodies according to one or more aspects described herein.

FIGS. **4**A and **4**B illustrate another example golf club head body according to one or more aspects described herein.

FIGS. **5**A and **5**B illustrate a golf club head cover for use with the golf club head bodies of FIGS. **3**A-**4**B according to one or more aspects described herein.

FIGS. **6**A and **6**B illustrate another golf club head body and cover arrangement according to one or more aspects described herein.

FIGS. **7**A and **7**B illustrate yet another golf club head body and cover arrangement according to one or more aspects described herein.

FIGS. **8**A-**8**D illustrate yet another golf club head body and cover arrangement according to one or more aspects described herein.

FIGS. **9**A and **9**B illustrate another golf club head body and cover arrangement according to one or more aspects described herein.

FIGS. **10**A and **10**B illustrate another golf club head body and cover arrangement having a sensor according to one or more aspects described herein.

FIG. **11** illustrates a golf club head arrangement with removable inserts according to one or more aspects described herein.

FIGS. **12**A-**12**C illustrate a golf club head arrangement having a void formed in a rear of the club head body and including a weight arrangement according to one or more aspects described herein.

FIGS. **13**A and **13**B illustrate another golf club head arrangement having a void and having a weight arrangement according to one or more aspects described herein.

FIGS. **14**A-**14**C illustrate another golf club head arrangement having a void in the rear of the golf club head body and an adjustable weight arrangement according to one or more aspects described herein.

FIGS. **15**A and **15**B illustrate another golf club head having a void and adjustable weight arrangement according to one or more aspects described herein.

FIG. **16** illustrates another golf club head having a void in the club head body and an adjustable weight arrangement according to one or more aspects described herein.

FIGS. **17**A and **17**B illustrate yet another golf club head arrangement having a void in the club head body and an adjustable weight arrangement according to one or more aspects described herein.

FIG. **18** illustrates another golf club head arrangement having adjustable weights according to one or more aspects described herein.

FIGS. **19**A and **19**B illustrate an example golf club head with adjustable weight arrangement according to one or more aspects described herein.

FIGS. **20**A and **20**B illustrate yet another golf club head and adjustable weight arrangement according to one or more aspects described herein.

FIG. **21** illustrates yet another golf club head having an adjustable weight arrangement according to one or more aspects described herein.

FIG. **22** illustrates still another golf club head and adjustable weight arrangement according to one or more aspects described herein.

FIGS. **23**A-**23**C illustrate another golf club head and adjustable weight arrangement according to one or more aspects described herein.

FIGS. **24**A and **24**B illustrate yet another golf club head and adjustable weight arrangement according to one or more aspects described herein.

FIGS. **25**A and **25**B illustrate still another golf club head and adjustable weight arrangement according to one or more aspects described herein.

FIG. **26** illustrates yet another golf club head and adjustable weight arrangement according to one or more aspects described herein.

FIGS. **27**A and **27**B illustrates yet another golf club head and adjustable weight arrangement according to one or more aspects described herein.

FIG. **28** illustrates yet another golf club head and adjustable weight arrangement according to one or more aspects described herein.

FIG. **29** illustrates another golf club head according to one or more aspects described herein.

FIG. **30** is a plan view of the golf club head shown in FIG. **29**.

FIG. **31** is a side view of the golf club head of FIG. **29**.

FIG. **32** is an opposite side view of the golf club head of FIG. **29**.

FIG. **33** is a bottom perspective view of the golf club head of FIG. **29**.

FIG. **34** is a bottom view of the golf club head of FIG. **29**.

FIG. **35** is a cross-sectional view of the golf club head of FIG. **29**, generally taken along line **35**-**35** in FIG. **30**.

FIGS. **35***a* and **35***b* are additional cross-sectional views of the golf club head of FIG. **29**.

FIGS. **36**-**38** illustrate further alternative embodiments of the golf club head, similar to the golf club head of FIG. **29**, according to one or more aspects described herein.

FIG. **39** illustrates another golf club head according to one or more aspects described herein, similar to the golf club head illustrated in FIG. **29**.

FIG. **40** is a side view of the golf club head of FIG. **39**.

FIG. **41** is an opposite side view of the golf club head of FIG. **39**.

FIG. **42** is a bottom perspective view of the golf club head of FIG. **39**.

FIG. **43** is a bottom view of the golf club head of FIG. **29**.

FIG. **44** is a cross-sectional view of the golf club head of FIG. **39**, generally taken along line **44**-**44** in FIG. **39**.

The figures referred to above are not drawn necessarily to scale, should be understood to provide a representation of particular embodiments of the invention, and are merely conceptual in nature and illustrative of the principles involved. Some features of the golf club and golf club head structures depicted in the drawings have been enlarged or distorted relative to others to facilitate explanation and understanding. In certain instances, the same reference numbers are used in the drawings for similar or identical components and features shown in various alternative embodiments. Golf clubs and golf club head structures as described herein may have configurations and components determined, in part, by the intended application and environment in which they are used.

DETAILED DESCRIPTION

In the following description of various example structures in accordance with the invention, reference is made to the accompanying drawings, which form a part hereof, and in which are shown by way of illustration various example articles, including one or more golf club or golf club head structures. Additionally, it is to be understood that other specific arrangements of parts and structures may be utilized and structural and functional modifications may be made without departing from the scope of the present invention. Also, while the terms "top," "bottom," "front," "back," "rear," "side," "underside," "overhead," and the like may be used in this specification to describe various example features and elements of the invention, these terms are used herein as a matter of convenience, e.g., based on the example orientations shown in the figures and/or the orientations in typical use. Nothing in this specification should be construed as requiring a specific three dimensional or spatial orientation of structures in order to fall within the scope of this invention. Further, the invention generally will be described as it relates to wood-type golf clubs. In particular, the club heads disclosed herein will be drivers and fairway woods in exemplary embodiments. However, aspects of the invention may be used with any of several types of golf clubs, including hybrid type

golf clubs, utility clubs, putters, and the like and nothing in the specification or figures should be construed to limit the invention to use with the wood-type golf clubs described.

FIG. **1** generally illustrates an example golf club **100** and/or golf club head **102** in accordance with this invention. In addition to the golf club head **102**, the overall golf club structure **100** of this example includes a hosel **104**, a shaft **106** received in and/or inserted into and/or through the hosel **104**, and a grip or handle **108** attached to the shaft **106**. Optionally, if desired, the external hosel **104** may be eliminated and the shaft **106** may be directly inserted into and/or otherwise attached to the head **102** (e.g., through an opening provided in the top of the club head **102**, through an internal hosel (e.g., provided within an interior chamber defined by the club head **102**), etc.). The hosel **104** may be considered to be an integral part of the golf club head **102** or could also be a separate structure attached to the golf club head **102**.

The shaft **106** may be received in, engaged with, and/or attached to the club head **102** in any suitable or desired manner, including in conventional manners known and used in the art, without departing from the invention. As more specific examples, the shaft **106** may be engaged with the club head **102** via the hosel **104** and/or directly to the club head structure **102**, e.g., via adhesives, cements, welding, soldering, mechanical connectors (such as threads, retaining elements, or the like) and further including releasable adjustable members or connectors, etc.; through a shaft-receiving sleeve or element extending into the body of the club head **102**; etc. The shaft **106** also may be made from any suitable or desired materials, including conventional materials known and used in the art, such as graphite based materials, composite or other non-metal materials, steel materials (including stainless steel), aluminum materials, other metal alloy materials, polymeric materials, combinations of various materials, and the like. Also, the grip or handle **108** may be attached to, engaged with, and/or extend from the shaft **106** in any suitable or desired manner, including in conventional manners known and used in the art, e.g., using adhesives or cements; via welding, soldering, adhesives, or the like; via mechanical connectors (such as threads, retaining elements, etc.); etc. As another example, if desired, the grip or handle **108** may be integrally formed as a unitary, one-piece construction with the shaft **106**. Additionally, any desired grip or handle **108** materials may be used without departing from this invention, including, for example: rubber materials, leather materials, rubber or other materials including cord or other fabric material embedded therein, polymeric materials, and the like.

The club head **102** itself also may be constructed in any suitable or desired manner and/or from any suitable or desired materials without departing from this invention, including from conventional materials and/or in conventional manners known and used in the art. For example, in the example club head **102** shown in FIG. **1**, the club head **102** includes a front face **102***a* that generally includes a ball striking surface **102***b* (optionally including a ball striking face plate integrally formed with the ball striking surface **102***a* or attached to the club head such that the face plate and a frame together constitute the overall ball striking surface **102***a*). The front face **102***a* may be considered a ball striking face **102***a*. The club head **102** may further include a top **102***c* or crown, a sole **102***d*, a toe **107** and a heel **109**. The club head **102** may also include a rear **111** (FIG. **1**B).

A wide variety of overall club head constructions are possible without departing from this invention. For example, if desired, some or all of the various individual parts of the club head **102** described above may be made from multiple pieces that are connected together (e.g., by welding, adhesives, or other fusing techniques; by mechanical connectors; etc.). The various parts (e.g., crown, sole, front face, rear, etc.) may be made from any desired materials and combinations of different materials, including materials that are conventionally known and used in the art, such as metal materials, including lightweight metal materials, and the like. More specific examples of suitable lightweight metal materials include steel, titanium and titanium alloys, aluminum and aluminum alloys, magnesium and magnesium alloys, etc. Additionally or alternatively, the various parts of the club head may be formed of one or more composite materials. Injection molded parts are also possible. The club head **102** also may be made by forging, casting, or other desired processes, including club head forming processes as are conventionally known and used in the art. The golf club head **102** could further be formed in a single integral piece.

The various individual parts that make up a club head structure **102**, if made from multiple pieces, may be engaged with one another and/or held together in any suitable or desired manner, including in conventional manners known and used in the art. For example, the various parts of the club head structure **102**, such as the front face **102***a*, ball striking surface **102***b*, the top **102***c*, the sole **102***d*, etc., may be joined and/or fixed together (directly or indirectly through intermediate members) by adhesives, cements, welding, soldering, or other bonding or finishing techniques; by mechanical connectors (such as threads, screws, nuts, bolts, or other connectors); and the like. If desired, the mating edges of various parts of the club head structure **102** may include one or more raised ribs, tabs, ledges, or other engagement elements that fit into or onto corresponding grooves, slots, surfaces, ledges, openings, or other structures provided in or on the facing side edge to which it is joined. Cements, adhesives, mechanical connectors, finishing material, or the like may be used in combination with the raised rib/groove/ledge/edge or other connecting structures described above to further help secure the various parts of the club head structure **102** together.

The dimensions and/or other characteristics of a golf club head structure according to examples of this invention may vary significantly without departing from the invention, and the dimensions may be consistent with those commonly used in the art for similar club heads and clubs.

Several embodiments of golf club heads are disclosed herein. It is understood that the description of the club head and various components described above regarding FIGS. **1**A and **1**B will apply to the other embodiments described herein. It will be appreciated that the several different embodiments may utilize a geometric weighting feature. The geometric weighting feature may provide for reduced head weight and/or redistributed weight to achieve desired performance. For example, more weight may be positioned towards the rear ends of the heel and toe of the club head. In the various embodiments disclosed herein, the golf club head may have a body having spaced legs defining a void, space or gap in between the legs. The club heads herein may be considered to have a portion removed to define the void, space or gap. The body may include a cover that is positioned over the void and/or the legs, and may be an integral component of the body or separately attached. Additional support members and/or weight assemblies may also be utilized with certain embodiments.

FIGS. **2**A-**2**C illustrate one example golf club head according to at least some aspects of the invention. The golf club head is generally designated with the reference numeral **200**. The golf club head **200** generally includes a golf club head body **202** and a cover **250**. As will be described in greater detail below, the body **202** has several structures and defines

various surfaces. The cover **250** is connected to the body **202** to form the golf club head **102**. As described herein, it is appreciated that the body **202** and cover **250** can be formed as an integral structure as well.

As further shown in FIG. **2**A, the golf club head body **202** further includes and defines a front **210**, a rear **212**, a top **214**, a toe **216**, a heel **218** and a sole (not shown in FIGS. **2**A-**2**C). The front **210** generally defines a ball striking face. The ball striking face may take various forms and in an exemplary embodiment, may utilize variable face thickness designs such as disclosed in U.S. patent application Ser. No. 13/211,961 which is incorporated by reference herein and made a part hereof. The ball striking face may further have a constant thickness. It is further understood that the ball striking face **210** may be separately connected to the golf club head body **202** such as in a welding process. The golf club head **200** may, in some arrangements, include a geometric weighting feature. In one exemplary embodiment, the club head **200** has a void **230**, gap, or space, formed generally in the rear **212** of the golf club head body **202**. The void **230** may, in some examples, be substantially v-shaped and may extend entirely through the golf club head **200** (e.g., from the top **214** to the sole). The golf club head body **202** further has a base **220** and a first leg **222** and a second leg **224**. The first leg **222** extends away from the front **210** or ball striking face **210** and the second leg **224** extends away from the ball striking face **210**. The void **230** is defined between the first leg **222** and the second leg **224**. The void **230** opens into the rear of the golf club head. The body **202** may form the hosel at the heel **218** of the body **202**. It is understood that the various structures of the body **202** may define an internal cavity having an internal volume.

As shown in FIG. **2**A, the void **230** may extend from a rear edge **212***a* of the golf club head **200**, inward, toward a center or central region of the golf club head **200** and towards the ball striking face **210**. The void **230** may be wider proximal the rear edge **212***a* of the golf club head than proximal the center of the golf club head **200**, thereby forming the v-shape. The void **230** formed in the golf club head **200** may reduce the overall weight associated with the golf club head, redistribute weight of the club, and may aid in adjusting the performance characteristics of the golf club head **200**. In some examples, the first leg **222** defines a first side **207** and the second leg defines a second side **209**. The sides **207**, **209** are generally in confronting relation. The sides **207**, **209** of the v-shaped void **230** may be generally linear. That is, the sides **207**, **209** may provide a generally flat surface. It is understood that the sides **207**,**209** may further be non-linear and define interrupted surfaces, or non-flat surfaces. As further shown in FIG. **2**A, as the void **230** is v-shaped, the legs **222**, **224** and the sides **207**, **209** converge towards the ball striking face **210** to an interface area **226**. The interface area **226** may be positioned in or proximate the central region of the club head **200** and this position may vary as described further herein. As described in greater detail below, the sides **207**, **209** and interface area **226** may have certain performance-enhancing structures associated therewith on internal surfaces in the internal cavity defined by the club head body **202**, as well as outer surfaces of the sides **207**, **209**. As also described in greater detail below, the legs **222**, **224** and interface area **226** may have moveable weight assemblies operably associated therewith to further enhance the performance characteristics of the golf club head **200**. The thicknesses of the material forming the golf club head body including materials making up the legs can also vary as desired. The volume of the internal cavity including the volumes of the legs could also be filled with a filler material if desired.

In some examples, the golf club head **200** may be formed as a single piece. For instance, the front **210**, rear **212**, top **214**, toe **216**, heel **218** and sole may be a single piece unit. The golf club head **200** may be formed using known methods of manufacture, such as casting, molding, forging, etc, and various combinations thereof. Thus, the golf club head body **202** may be cast in a metal material such as titanium. The void **230** may be formed in the golf club head during the initial manufacturing process of the golf club head (e.g., during casting) or may be formed into the golf club head **200** using an additional process (e.g., by cutting).

In some arrangements, a recess **203** may be formed in the top **214** of the golf club head body **202**. The recess **203** may form a ridge or lip **205** around a perimeter, or substantially around a perimeter, of the golf club head **200**. The recess may vary in depth and may be between 0.1 and 0.3 inches deep. The recess **203** may be configured to receive a cover, such as the cover **250**, which will be discussed more fully below. Further, in examples in which the recess **203** is configured to receive the cover **250**, the recess **203** may be shaped to correspond to the cover **250**.

As mentioned above, and as shown in FIGS. **2**A and **2**B, the golf club head **200** further includes the cover **250**. The cover **250** may, in some examples, cover the rear **212**, or a portion of the rear **212**, of the golf club head body **202** such that the void **230** is not visible when the golf club head **200** is in use, especially when the golf club head **200** is at an address position with the golfer standing over the golf club head **200**. That is, with the cover **250** in position, the golf club head **200** may appear similar to a conventional golf club head that does not include a void **230** in the rear **212** of the golf club head **200**. However, the performance advantages (e.g., reduced weight, redistributed weight, etc.) would be provided. The cover **250** may, in some examples, extend over the top **214** of the golf club head body **202** such that the void **230** may be visible when the golf club head **200** is viewed from the sole but the void **230** may be obstructed from view when viewed from the top of the club **200**. Additionally or alternatively, the cover **250** may extend over the entire rear **212** of the golf club head **200** and may cover the top and sole of the golf club head such that the void is not visible when the golf club head is viewed from any angle.

In some arrangements, the cover **250** may be received in the recess **203** formed in the top **214** of the golf club head **200**. In some examples, the depth and/or shape of the recess **203** may correspond to the thickness and/or shape of the cover **250**. For instance, when the cover **250** is installed on the golf club head **200**, a top surface of the cover **250** may be flush with a top of the ridge or lip **205** formed by the recess **203**.

The cover **250** may be formed of any suitable material, such as lightweight metals, alloys, composite, plastic, etc. A polymer-based cover **250** may further have a nano-coating to provide a metallic-type finish or some other treatment to provide such look. The cover **250** may be connected to the golf club head using known methods of connection, including mechanical fasteners, snap fits, screws, adhesives, friction fits, and the like. In some examples, the cover **250** may be connected to the golf club head **200** by a friction fit between the ridge or lip **205** formed by the recess **203** on the top **214** of the golf club head **200**.

In some arrangements, the cover **250** may be removable and or interchangeable with other covers. For instance, FIG. **2**A illustrates the golf club head **200** with the cover **250** removed. FIG. **2**B illustrates the golf club head **200** with the cover **250** partially in place, while FIG. **2**C illustrates the golf club head **200** with the cover **250** in place along the top of the golf club head **200**. The cover **250** generally forms the crown

of the golf club head **200**. As shown in FIGS. **2**A-**2**C, when the cover **250** is in place, the void **230** is not visible from the top **214** of the golf club head **200**. That is, in an address position, a user would not be able to see the void **230** formed in the golf club head **200**. Rather, the golf club head **200** would have the appearance of a conventional golf club head. As shown in FIG. **2**C, the golf club head **200** appears similar to a conventional golf club head when viewed from the top with the cover **250** in place.

In some arrangements, the cover **250** may be interchangeable with other covers having different performance characteristics. For instance, the cover may be interchanged with other covers having different weighting characteristics. Alternative covers may further have different aesthetic characteristics or may incorporate different training guides.

FIGS. **3**A-**3**D illustrate another golf club head arrangement for a golf club head **300** and having golf club head body and a cover wherein the cover may be considered to be a portion of the club head body. The golf club head **300** has a void **302** formed in the rear **312** of the golf club head **300**. Similar to the golf club head **200** of FIGS. **2**A-**2**C, the golf club head **300** includes a front, a rear, a top, a sole, a toe and a heel. The golf club head **300** further includes a pair of spaced legs that define the geometric weighting feature in the form of a void **302** formed in the rear **312** of the golf club head **300**. As shown in FIGS. **3**A and **3**B, the void **302** may be substantially v-shaped in some examples. The void **302** may be other shapes as desired. For instance, a square, rectangular, triangular, etc. shaped void may be used without departing from the invention.

The top of the golf club head body may include a plurality of angled surfaces **320***a*-**320***c*. In some examples, the angled surfaces **320***a*-**320***c* may be generally planar and may extend downward, from a top edge **321** of the front of the golf club head **300** to a top edge **323** of the v-shaped void **302**. That is, the top of the golf club head **300** may gradually slope downward, from a top edge **321** of the front of the golf club head to the top edge **323** of the void. In some examples, the top may be formed of multiple angled surfaces **320***a*-**320***c*. For instance, FIG. **3**A illustrates three angled surfaces **320***a*-**320***c* extending downward, from the top of the golf club head toward the sole. The three angled surfaces may extend in differing directions (e.g., from front to rear, toe to heel, heel to toe, etc.) to form the top surface of the golf club head **300**.

The angled surfaces **320***a*-**320***c* forming the top of the golf club head **300** may further aid in reducing weight associated with the golf club head and/or redistributing weight to adjust the center of gravity of the golf club head **300**. That is, the angled surfaces **320***a*-**320***c* allow for removal of additional material that would form a conventional golf club head. That additional material may add additional weight to an upper portion of the golf club head, thereby moving the center of gravity upward, which may not be desirable. Accordingly, providing the angled surfaces **320***a*-**320***c* aids in moving the center of gravity downward, toward a sole of the golf club head **300**. It is further understood that the legs of the club head body may be dimensioned differently wherein surface areas of the angled surfaces are also different. Such differences in the legs can further adjust the performance characteristics of the golf club.

The void **302** may then extend entirely through the rear of the golf club head, from the top of the body to the sole of the golf club head. As shown in FIGS. **3**A and **3**B, the void **302** may extend inward, from a rear edge of the golf club head toward a center portion of the golf club head, and the void may be wider proximal the rear edge than proximal the center of the golf club head wherein it is understood that the legs converge to an interface area.

Similar to the arrangement discussed above, the golf club head **300** may further include a cover **350** that may be received on the top surface of the golf club head **300**. FIGS. **3**C and **3**D illustrate the golf club head with the cover **350** in place. Similar to the arrangement discussed above, the cover **350** may be received in a recess **303** formed in the top of the body of the golf club head **300**. In some examples, the cover **350** may extend over one or more exterior sides of the golf club head **300**, as shown in FIG. **3**C.

The cover **350** may be connected to the golf club head using known methods of connection, such as mechanical fasteners, adhesives, friction fits, snap fits, and the like. Further, the cover **350** may be formed of known materials, such as plastics, composites, metals, etc.

Similar to the arrangement discussed above, the cover may obscure the angled surfaces **320***a*-**320***c* of the top of the golf club head **300** and the v-shaped void **302**. Thus, when viewed from the top or in an at address position, the golf club head **300** may have the appearance of a conventional golf club head when the cover **350** is installed.

FIGS. **4**A and **4**B illustrate another example golf club head according to one or more aspects described herein. The golf club head **400** may include a recessed region **403** in the rear of the golf club head **400**. The recess **403** may aid in reducing overall weight associated with the golf club and may aid in moving the center of gravity lower on the golf club head by reducing weight near the top of the golf club head. The recessed region **403** may be formed by sidewalls **420**. The sidewalls **420** may extend downward, from a top of the golf club head toward a sole of the golf club head and may be substantially vertical. In some examples, at least one sidewall may be substantially parallel to the front of the golf club head, or generally parallel to a ball striking face. In other examples, the sidewalls **420** may be angled.

The golf club head **400** may further include a geometric weighting feature in the form of a void **402** formed in a bottom surface of the recessed region **403**. In some examples, the void **402** may be substantially v-shaped and may aid in reducing weight associated with the golf club head, or may also further redistribute weight towards the rear of the heel and toe. The void **402** may extend from a rear edge of the golf club head inward, toward a center of the golf club head. In some examples, the void may extend completely through the rear of the golf club head (e.g., from the bottom surface of the recessed region to the sole of the golf club head) and may be wider proximal the rear edge of the golf club head than the center of the golf club head. In some arrangements, the void may include sides that are substantially planar.

Similar to the arrangements discussed above, the arrangement of golf club head **400** may aid in reducing overall weight and/or redistributing weight associated with the golf club head and may alter the performance characteristics of the golf club head. However, the golf club head **400** may not look like a conventional golf club head, which may be distracting to players and may not conform with one or more parameters of golf club design requirements. Accordingly, a cover may be provided to provide the appearance of a conventional golf club head while still providing the performance advantages of the golf club heads having voids as discussed above.

FIGS. **5**A and **5**B illustrate the golf club head **400** including a cover **550** extending over at least a portion of the rear of the golf club in order to provide the appearance of a conventional golf club head. The cover arrangement of FIGS. **5**A and **5**B may also be used with other golf club heads described herein

(such as golf club head **200**, golf club head **300**, and other embodiments). The cover **550** may extend over the top of the golf club head **400** such that it obscures the void and/or recessed region of the golf club head and provides the appearance of a conventional golf club head. The cover **550** may be connected to the golf club head **300** or **400** using known methods of connection, such as mechanical fasteners, snap fits, friction fits, adhesives, and the like.

In some arrangements, as shown in FIG. **5**B, the cover **550** may extend over a top edge of the golf club head and along a side of the golf club head. Thus, the cover **550** may include a depending peripheral skirt **551**. This may aid in providing a conventional appearance for the golf club head. The golf club head cover **550** may cover the entire rear of the golf club head **400** (e.g., extend over the top and sole of the golf club head from the toe to the heel) to obscure the void from all angles of the golf club head. Alternatively, the cover **550** may extend over the top of the golf club head (e.g., from the rear to the front and from the toe to the heel along the top of the golf club head) to obscure the void **402** and/or recessed region when the golf club head **400** is viewed from the top (e.g., an at address position). However, in this arrangement, the void may still be visible when the golf club head is viewed from the bottom or sole.

FIGS. **6**A and **6**B illustrate one arrangement in which a cover **650** extends over a top of a golf club head **600** such that a void **602** formed in the golf club head **600** is obscured when viewed from the top but visible when viewed from the bottom or sole of the golf club head. FIG. **6**A illustrates the sole **615** of the golf club head **600**. As shown, the golf club head **600** includes a substantially v-shaped void **602** formed in the rear of the golf club head **600** and extending generally from the rear edge of the golf club head inward, toward a center of the golf club head **600**. The void **602** may be similar to other voids described herein. The void **602** is visible when the golf club head **600** is viewed from the bottom or sole. However, when viewed from the top, the golf club head has the appearance of a conventional golf club head, as shown in FIG. **6**B.

The cover **650** of FIGS. **6**A and **6**B may generally cover the top of the golf club head **600** and may somewhat wrap around the top of the golf club head to cover a portion of the sides of the golf club head (similar to some arrangements discussed above). Accordingly, the cover **650** may also have a depending skirt **651**.

FIGS. **7**A and **7**B illustrate a golf club head **700** (similar to the golf club head **600** of FIG. **6**A) having a cover **750** extending over the top surface of the golf club but not wrapping around to cover a portion of the sides of the golf club head. Thus, the void **702** formed in the golf club head is visible from the sole of the golf club head **700**, but not from the top of the golf club head **700**. In the arrangement of FIGS. **7**A and **7**B, an underside of the cover **750** is visible from the sole of the golf club head **700** (e.g., through the void **702**).

In some examples, the cover **750** may be received in a recess (similar to recess **203** of FIG. **2**) formed in the top of the golf club head. Further, the recess may have a depth and/or shape that corresponds to a thickness and/or shape of the cover **750** such that a top surface of the cover **750** will be flush with the top of the lip or ridge formed by the recess in the golf club head **700**.

FIGS. **8**A-**8**D illustrate another example golf club head according to one or more aspects described herein. The golf club head **800** may include a void **802** arranged in a rear of the golf club head and extending from the top to the sole of the golf club head (similar to the arrangements described above). The void **802** may extend from a rear edge **804** of the golf club head inward, toward a center or central region **806** of the golf club head and may be substantially v-shaped. In some examples, the void **802** may have other shapes, such as substantially square, rectangular, triangular, and the like. Similar to the arrangement discussed above, the void may have a greater width at the rear **804** of the golf club head **800** than near the central region **806**. That is, the void **802** may narrow as it extends from the rear **804** to the central region **806** to form the v-shape. In some examples, the void **802** may have sides that are generally planar forming a smooth, substantially flat inner surface of the void **802** and may include a generally curved portion at a base of the v-shape, near the central region **806**, which may be referred to as an interface area.

Similar to the arrangements discussed above, golf club head **800** may include a cover **850** configured to obscure the void, or portions of the void, when the golf club head **800** is viewed from the top (e.g., an at address position). FIG. **8**B illustrates a top view of the golf club head **800** having a cover **850** arranged along the top of the golf club head **800** to cover the void **802**. In the arrangement shown, the cover **850** may be shaped to correspond to the shape of the void **802** and, in some examples, may connect to the golf club head **800** to cover only the void **802**. That is, the cover **850** may cover only the void **802** and may not cover any portion of the rear of the golf club head **800** (other covers discussed herein may also cover only the void or may cover other portions of the rear, sides, etc. of the golf club head). FIG. **8**C illustrates the cover **850** partially removed from the golf club head **800**. The cover **850** is shaped to correspond to the shape of the void **802** in order to fit into the top of the golf club head **800** and cover the void **802** along the top of the golf club head. The cover may be connected to the golf club head **800** using known methods of attachment, such as adhesives, mechanical fasteners, snap fits, friction fits, etc. In some examples, the cover may slide into slots arranged along a top portion of the generally planar sidewalls of the void **802**. The slots may provide a friction fit and/or may include additional fasteners to secure the cover **850** to the golf club head **800**.

FIG. **8**D illustrates the golf club head **800** from the bottom or sole. The void **802** is visible when the golf club head **800** is viewed from this side, and a bottom surface of the cover **850** is also visible. In some examples, the cover **850** may be removable and/or replaceable with other covers having differing performance characteristics. It is understood that in further alternative embodiments, additional structures can be a part of or associated with the cover **850** to provide desired characteristics of the club head.

FIGS. **9**A and **9**B illustrate yet another golf club head arrangement according to one or more aspects described herein. FIG. **9**A provides a perspective and toe side view of a golf club head **900** having a cover **950**, while FIG. **9**B provides a perspective and toe side view of the golf club head **900** of FIG. **9**A with the cover **950** removed showing the club head body.

As shown in FIG. **9**B, the golf club head **900** may include an open rear arrangement in which a portion of the top and sides of the rear of the golf club head **900** have been removed. That is, the rear of the golf club head **900** may include a substantially planar portion **908** located near a bottom or sole of the golf club head **900**. In some arrangements, the substantially planar portion **908** may be the sole of the golf club head. The rear of the golf club head **900** may further include a plurality of sides **915***a*-**915***c* extending from a top of a base of the body of the golf club head **900** to the substantially planar lower portion **908**. The sides **915***a*-**915***c* may, in some examples, be substantially vertical. Further, one or more sides **915***a*-**915***c* may be angled with respect to another of sides

915*a*-915*c* (e.g., side 915*a* is angled with respect to 915*b*, side 915*c* is angled with respect to 915*b*).

This open rear arrangement may aid in reducing weight associated with the golf club head and may aid in lowering the center of gravity of the golf club head **900**. In addition, weight may also be distributed more towards the rear of the heel and toe of the club head.

In some examples, the golf club head **900** may further include a void **902** formed in the substantially planar lower portion **908** of the golf club head **900**. The void **902** may, in some examples, be substantially v-shaped and may extend from a rear edge **904** of the golf club head inward, toward a center or central region of the golf club head **906**, similar to the arrangements discussed above. Such a geometric weighting feature assists in distributing weight towards the rear of the heel and toe of the club head.

As shown in FIG. **9**A, the golf club head **900** may include a cover **950**. The cover **950** may extend over the substantially open rear arrangement of the golf club head **900** to provide the appearance of a conventional golf club head when the golf club head **900** is viewed from the top. In some arrangements, a portion **952** of the cover **950** may extend over a portion of a side of the golf club head **900**. This may aid in maintaining the aerodynamic characteristics of the golf club head **900** and may also aid in providing the appearance of a conventional golf club head. In some examples, a gap **954** may be formed between the cover **950** and the bottom or sole **908** of the golf club head. This gap **954** may further reduce the overall weight associated with the golf club head **900**.

FIGS. **10**A and **10**B illustrate another golf club head arrangement according to one or more aspects described herein. The golf club head **1000** of FIG. **10**A may include one or more sensors **1020***a* arranged within the golf club head. In some examples, the sensor **1020***a* may be arranged with the void formed in the rear of the golf club head and/or may be connected to a cover **1050***a* cove ring a portion of the void. In particular, an underside surface of the cover of the club head has an opening to receive the sensor. The opening is dimensioned to correspond in size to the sensor **1020***a* wherein the sensor is received in the opening. The sensor **1020***a* may be secured in the opening in an interference or friction fit or other mechanical fastening mechanisms can be utilized. The sensor **1020***a* may record and/or transmit performance data to a computing device (not shown). For instance, the sensor **1020***a* may detect performance data such as swing speed and transmit the data to a computing device that may be accessed by a user to track various performance characteristics. The data may be transmitted wirelessly using known methods of data transmission, or, in some examples, the sensor **1020***a* may be removed and connected to a computing device, such a via a USB port. As can be appreciated from FIG. **10**A, the sensor **1020***a* is accessible from a sole of the club head through the void.

In some examples, the cover, or portion thereof, may be removable to access the sensor **1020***a*. For instance, FIG. **10**B illustrates a golf club head **1000***b* which may also include a sensor **1020***b* connected thereto (e.g., to cover **1050***b*) to track and/or transmit performance data. The cover **1050***b* is shown partially removed from the golf club head **1000***b* to illustrate that the sensor **1020***a* may be accessed, removed, etc., as desired.

In some arrangements, the golf club heads described above, as well as those described below, may include one or more weights, weight assemblies, mechanisms or weighting features. The weighting features may be removable, adjustable, etc., as will be discussed more fully below. The weighting features described herein may be used, alone or in combination with other weighting features described herein, with any golf club head described herein and are not limited to the golf club head with which they are described.

FIG. **11** illustrates another example golf club head according to one or more aspects described herein. The golf club head **1100** may include one or more recesses formed in a sole of the golf club head **1100**. One or more inserts **1130** may be inserted into the recesses. The inserts **1130** may be removable and/or interchangeable with other inserts to adjust one or more performance characteristics of the golf club head **1100**. For instance, the inserts **1130** may have different properties to adjust the moment of inertia or center of gravity of the golf club head **1100**. The inserts **1130** may be formed of any suitable material, such as lightweight metals, metal alloys, composite materials, plastic, etc. In some arrangements, the inserts **1130** may slide into the recess and be held in place by friction. Additionally or alternatively, the inserts **1130** may be connected to the golf club head **1100** by one or more screws or mechanical fasteners, snap fits, adhesives, and the like.

In some examples, the inserts **1130** may have different weighting characteristics to adjust performance of the golf club head **1100**. The inserts **1130** may be the same weight as each other or different weights. In still other examples, the inserts **1130** may be removably connected to the golf club head in order to allow for replacement of the inserts with those having different weighting characteristics or other features.

FIGS. **12**A-**12**C illustrate another example golf club head according to one or more aspects described herein. The golf club head **1200** may include an arrangement similar to those described above in which a void **1202** is formed in the rear of the golf club head. In addition, the golf club head **1200** may include one or more weights **1240** arranged within the golf club head **1200**. The weights may be provided to adjust the performance characteristics of the golf club head **1200**. For instance, the weights **1240** may adjust the center of gravity, moment of inertia, etc. of the golf club head **1200**. The weights may, in some arrangements, be removable and/or interchangeable with other weights to adjust the performance characteristics of the golf club head **1200**. That is, the open void **1202** provided in the rear of the golf club head **1200** may permit access to the weights **1240** (as shown in FIG. **12**B). Thus, the weights **1240** may be removed from the golf club head **1200** and/or interchanged with other weight members.

In some examples, the weights **1240***a* and **1240***b* may have different weight characteristics. For instance, weight **1240***a* may be lighter than weight **1240***b* in order to adjust the center of gravity of the golf club head lower on the head **1200**. The weights **1240***a* and **1240***b* may then be interchanged to adjust the performance characteristics of the golf club head **1200**, or may be interchanged with other weight members (not shown in FIGS. **12**A-**12**C) to further adjust the performance characteristics of the golf club head **1200**. As can be appreciated from FIGS. **12**B and **12**C, the weight ports could be positioned in areas of the club head generally not possible with traditional club heads. Because of the structure defining the void in the club head, the weight ports are more readily accessible.

FIGS. **13**A and **13**B illustrate another golf club head arrangement having a void **1302** formed in the rear of the golf club head and one or more weights **1340**. Similar to the arrangements discussed above, the void **1302** may be substantially v-shaped or may have other shapes, as discussed above. The weights **1340** may be adjustable, removable, interchangeable, replaceable, etc. and may be accessed, in some examples, via the void **1302** formed in the rear of the golf club head **1300**. For instance, as shown in FIGS. **13**A and **13**B,

weight **1340***b* may be accessed from an interface area or from a base of the void (e.g., the bottom of the v-shape). The weights **1340***a*, **1340***b* may be connected to the golf club head using mechanical fasteners, adhesives, snap fits, etc. In some examples, the weights **1340** may be connected to the golf club head **1300** with screws. Accordingly, the screw may be accessed and removed via the void **1302** to remove weight **1340***b*.

Further, the void **1302** may provide a gap **1317** through which the weight **1340***a* may be accessed. Accordingly, a screw or other fastener connecting weight **1340***a* may be removed via the gap **1317** and the weight may be adjusted, removed, replaced, etc.

Similar to the arrangement described above with respect to FIGS. **12**A and **12**B, the weights **1340***a* and **1340***b* may have different weights or weight characteristics in order to adjust performance of the golf club head **1300**. The weights may be formed of any suitable material.

FIGS. **14**A-**14**C illustrate another golf club head arrangement according to one or more aspects described herein. The golf club head **1400** may include a void **1402** formed in the rear of the golf club head **1400**. In addition, the golf club head **1400** may include a weight **1440** arranged in the rear of the golf club head **1400**. In some examples, the weight **1440** may have two sides **1440***a*, **1440***b*, each having different properties. For instance, one side **1440***a* of weight **1440** may be heavier than a second side **1440***b* of the weight **1440**. This difference in weight characteristics may be due to different materials used, density of materials used, etc. in forming the weight **1440**. The moveable weight **1440** is capable of altering the performance characteristics of the golf club head.

Additionally or alternatively, the structure of each side may be different. For instance, as shown in FIG. **14**C, one side **1440***b* of the weight may be hollow to reduce weight associated with that side, while the other side **1440***a* may be solid to make it heavier.

The weight may be removably connected to the golf club head via screws or other mechanical fasteners, and the like. That is, the user may access the fastener of the weight **1440** via the void **1402** in the rear of the golf club head **1400** in order to remove, adjust, etc. the weight **1440**. The weight **1440** may be removed from the golf club head **1400** and a user may rotate or flip the weight **1440** and connect it in different configurations in order to adjust the performance characteristics of the golf club head. That is, adjustment of the weight **1440** may adjust the weight characteristics (and thus the performance characteristics) in a high to low or top to sole manner (e.g., adjusting the center of gravity of the golf club head **1400** higher or lower on the golf club head **1400**).

FIGS. **15**A and **15**B illustrate another example of an adjustable weight arrangement in which a golf club head **1500** may have an adjustable, removable, etc. weight **1540**. In the arrangement shown, the weight **1540** may again have two sides or ends, each having different weighting characteristics to allow for adjustment of the performance characteristics of the golf club head **1500** with adjustment of the weight **1540**. As shown in FIG. **15**B, the weight may be connected at two points in this arrangement, rather than one point as shown in FIGS. **14**A-**14**C. However, the single point of connection may be used with this arrangement without departing from the invention.

Similar to the arrangement described above, the weight **1540** may be substantially v-shaped (as shown in FIG. **15**B) and may extend over a base of the void **1502**. At the interface area at the void **1502**, the club head body may have a projection **1510** that extends away from the ball striking face and towards or into the void **1502**. As shown in FIG. **15**B, the weight **1540** defines a cavity dimensioned to receive the projection **1510**. Once secured, the weight **1540** fits and conforms about the projection **1510**. The weight **1540** may include multiple ends having different characteristics, such as weight characteristics. For example, one end **1540***a* may be heavier than the other end **1540***b*. This may be due to a difference in materials used to construct the weight or, in some examples, the structure of the ends **1540***a*, **1540***b*. For instance, one end, such as end **1540***a*, may be thicker than the other end **1540***b*. The added thickness of material may result in additional weight that may be used to adjust the performance characteristics of the golf club head **1500**. The ends **1540***a*, **1540***b* may also support additional weight elements thereon. As can be appreciated from FIG. **15**B, the weight **1540** can be rotated or adjusted such that a heavier end of the weight **1540** is positioned either closer to the crown or closer to the sole of the club head **1500**.

Similar to the arrangement in FIGS. **14**A-**14**C, the weight may be accessed via the void **1502** and may be removed and replaced in an alternate configuration (second side down vs. second side up, etc.) in order to adjust the performance characteristics of the golf club head. In some examples, the weight **1540** may be a single piece member, while in other examples, the weight **1540** may be formed of multiple pieces joined together or separately connected to the golf club head **1500**. As further shown in FIG. **15**B, a pair of threaded fasteners are used to secure the weight **1540** to the club head **1500**. Because the structure of the club head **1500**, the void **1502** provides ready access to the fasteners for removal or adjustment of the weight **1540**. As further shown in FIG. **15**A (while not shown in FIG. **15**B), the club head **1500** may have a channel **1550** extending across the sole of the club head **1500** from a heel to a toe and generally adjacent the ball striking face. The channel allows a certain amount of compression of the club head upon ball impact. This feature may cooperate with the other club head structures and weighting characteristics to further enhance performance of the club.

FIG. **16** illustrates yet another golf club head **1600** according to the present invention. As discussed with other embodiments, the golf club head **1600** has the body **1602** having a first leg **1622** and second leg **1624** that are spaced by a void **1630**. The void **1630** is generally v-shaped similar to other embodiments. The golf club head **1600** further defines an interface area **1626**. A cover **1604** is integral with or otherwise connected to the body **1602**. The first leg **1622** and second leg **1624** converge toward one another to the interface area **1626**.

The golf club head **1600** utilizes a weight assembly to further enhance performance of the club head **1600**. The weight assembly or weight is operably associated with the interface area **1626**. In an exemplary embodiment, the interface area **1626** of the head **1600** supports a receptacle or receiver **1642** in the form of a receiving tube **1642** in an exemplary embodiment. A weight **1640** of the weight assembly is configured to be received by the receiving tube **1642**. FIG. **16** shows the weight **1640** both in the tube **1642** and further in an exploded configuration. The weight **1640** may, in some examples, be received in the receiving tube **1642** incorporated into the golf club head **1600** and, in some arrangements, arranged at the base of the v-shaped void **1602** formed in the golf club head **1600**. Thus, as shown in FIG. **16**, the interface area **1626** supports the receiving tube **1642** generally at the junction of the first leg **1622** and the second leg **1624**. The first leg **1622** and the second leg **1624** converge to the receiving tube **1642**. The receiving tube **1642** generally has a height that extends from an underside of the cover **1604** to proximate the sole surface of the club head body **1602**. The receiving tube **1642** may have varying heights as desired and

be mounted have one or both ends spaced away from the underside of the crown or sole. It is understood that the weight **1640** may have one end **1640***a* that is heavier than an opposite end **1640***b* wherein the weight **1640** can be flipped as desired. Thus, differing weighting characteristics and arrangements are possible to alter the performance characteristics of the club head **1600**. A threaded fastener **1644** can also be provided to mate with internal threads in the receiving tube **1642** to secure the weight **1640** in the receiving tube **1642**.

The receiving tube **1642** and weight **1640** may have corresponding shapes such that the weight **1640** may slide into the receiving tube **1642**. In some examples, the weight **1640** and receiving tube **1642** may be cylindrical, square, rectangular, etc. The receiving tube **1642** may have a longitudinal axis and the weight may have a longitudinal axis. The longitudinal axes may generally correspond when the weight **1640** is received in the tube **1642**. In the embodiment shown in FIG. **16**, the longitudinal axis of the tube **1642** is generally vertical and generally parallel to the ball striking face with the understanding that the ball striking face may have a certain amount of loft. The received tube **1642** may be integrally formed with one or more portions of the golf club head **1600** or may be formed as a separate portion and connected to the golf club head **1600** using known methods of connection, such as adhesives, mechanical fasteners, snap fits, and the like.

In the example shown in FIG. **16**, the receiving tube **1642** is generally vertical in arrangement (e.g., in a vertical position when the golf club head is in an at address position). However, various other tube arrangements, positions, etc. may be used without departing from the invention. Some other arrangements, positions, etc. will be described more fully below.

The receiving tube **1642** may receive the weight **1640** which may be a single weighted member or may have ends with different weighting characteristics or weight values. For instance, the weight **1640** may have one end **1640***a* heavier than an opposite end **1640***b*. In some arrangements, the heavier end may be positioned towards the top of the golf club head to provide a first weight arrangement or alternatively, towards the bottom of the golf club head to provide a second weight arrangement. The different weight arrangements can affect performance of the club head **1600**. The v-shaped void **1630** may permit easier access to the body of the golf club head **1600**, weights **1640**, etc. to more easily adjust weight from a high position to a low position. Other structures can be operably associated with the interface area at the void **1630** to removably support weight members thereon.

Additionally or alternatively, the weight member **1640** may include multiple weights or portions of the weight **1640** that can be releasably fastened to one another; e.g. three pieces with one piece being heaviest (e.g., shown in phantom lines in FIG. **16**). The different weights may also have different weight values. In some examples, the heavy member can be at either end or at a middle of the member. Various other combinations of weight members may be used without departing from the invention. The overall height of the weight member **1640** along with the length of the threaded fastener **1644** may generally correspond to the height of the receiver tube **1642** so that the weight **1640** fits snugly in the tube **1642** and does not slide within the tube during use. It is understood that the tube **1642** and/or the weight **1640** may have shock absorbing features if desired.

In some arrangements, the base of the v-shaped void may be angled and the receiving tube **1642** may conform to the angle. Thus, the weight member may be adjusted in a hybrid fashion, e.g., high/low, fore/aft, by adjusting the weight **1640** within the receiving tube **1642**. Multiple receiving tubes **1642** can also be utilized in vertical, horizontal or angular configurations. The receiving tube(s) may also be positioned at locations spaced away from the interface area **1626** including along surfaces of the first leg **1622** and the second leg **1624**.

The position of the weight **1640** and receiving tube **1642** at the base of the v-shaped void may aid in adjusting the center of gravity near a central region of the golf club head **1600**. Weight in the tube **1642** can be focused in the tube **1642** to provide a low center of gravity or a high center of gravity. The weight **1640** can also be configured to provide a more neutral center of gravity. The insertion or removal of weight **1640** may add or remove additional weight from the overall weight of the golf club head **1600** and may add or remove weight from the central region, thereby adjusting the performance characteristics of the golf club head **1600**. Such weighting characteristics provided by the weight **1640** in the tube **1642** can further impact golf ball trajectory by providing a change in ball spin. It has been determined that this weighting feature can provide a change of approximately 500-600 rpm in ball spin. Utilizing the adjustable weight **1640** in the tube **1642** to affect ball spin as well as considering launch angle and ball speed, a golfer can customize the golf club to achieve desired ball trajectory, distance and other characteristics. The adjustable weighting feature can further be used to customize the club head **1600** to produce a desired ball spin for a particular golf ball being used.

The weight assembly utilized in FIG. **16** can also take certain alternative forms. For example, the club head body can be formed such that the first leg and the second leg define the v-shaped void therebetween. In this embodiment, the void extends completely from a crown of the club head to a sole of the club head. The sides of the legs facing into the void may be closed with material defining side surfaces or the sides of the legs could have an open configuration. A cover member can be provided that is also v-shaped to correspond to the v-shaped void. The cover member has a top portion and depending legs as well as structure defining the receiving tube therein. The receiving tube is configured to receive the weights as described above. The cover member is positioned in the v-shaped void wherein the top portion of the cover member is attached to the crown of the club head body. The depending legs of the cover member confront the legs of the club head body and may also be connected to the legs of the club head body. As such, a club head body is formed similar to the club head shown in FIG. **16**. In one exemplary embodiment, the club head body is a cast metal body such as titanium. The cover member is formed in a plastic injection molding operation. The plastic cover member reduces the overall weight of the club head as opposed to such corresponding structures also being made from metal such as titanium. Coating operations could be utilized on the plastic cover member to provide a metallic appearance and to further strengthen the member. It is further understood that in the various embodiments described herein utilizing additional weight members, the weight members may be of a material heavier than the remainder of the golf club head or portions of the head. In other exemplary embodiments, the weight member(s) may be made of the same material as the remainder of the golf club head or portions thereof. In certain exemplary embodiments, the weight member may be formed from steel, aluminum, titanium, magnesium, tungsten, graphite, or composite materials, as well as alloys and/or combinations thereof.

FIGS. **17**A and **17**B illustrate another weight arrangement similar to FIG. **16**. The golf club head **1700** may include club head body defining a v-shaped void **1702** in the rear of the golf club head **1700**. The club head body has the pair of spaced legs defining the void **1702** wherein the legs converge and an

interface area is defined in the club head body. Further, the golf club head **1700** may include a weight **1740** arranged in the interface area or generally at or proximate a central region of the golf club head (e.g., at the base of the v-shaped void **1702**). The weight assembly or weight is operably associated with the interface area. Similar to the arrangement of FIG. **16**, the weight may be cylindrical and may be received in a receiver such as a receiving tube **1742** in an exemplary embodiment.

Similar to the arrangement discussed above, the weight may have ends having different weighting characteristics or weight values. For instance, one end **1740***a* may be heavier than the other end **1740***b*. The additional weight may be due to end **1740***a* being a larger portion of the weight **1740** (as shown in FIG. **17**B) or the material used to form the weight may differ for each end. The weight **1740** may be removed from the receiving tube **1742** and rotated or flipped to adjust the weight distribution associated with the weight **1740**. That is, the heavier end may be proximal an upper portion of the receiving tube **1742** (e.g., proximal the sole of the golf club head) or the weight **1740** may be reversed so that the heavier end is proximal the top or crown of the golf club head **1740**.

Additionally or alternatively, the weight may be comprised of multiple weight portions having varying weight characteristics, as described above. For instance, portions **1740***a* and **1740***b* may be separate portions of the weight **1740** that may be connected together in multiple configurations to adjust the weight distribution and thereby adjust the performance characteristics of the golf club head **1700**. Although two weight portions are shown in FIG. **17**B, three or more portions may be used to form the weight **1740** as desired.

In some examples, the receiving tube **1742** may include a fastener **1750** to secure the weight **1740** within the receiving tube **1742**. For instance, a screw or other threaded fastener **1750** may be inserted into the receiving tube **1742** after the weight **1740** has been inserted to maintain the position of the weight **1740**. The receiving tube **1742** has mating threads to receive the threaded fastener **1750**. In order to remove or adjust the weight, the fastener **1750** may be removed and the weight **1740** may then be removed. Similar to the arrangements discussed above, access to the weight **1740** and fastener **1750** may be via the void **1702** formed in the rear of the golf club head **1700**. It is understood that the weight **1740** could be secured in the tube **1740** in several other alternative embodiments.

Additionally or alternatively, the weight **1740** may be threaded or connected to a threaded fastener **1750** such that adjustment of the thread moves the weight **1740** within the receiving tube **1742**. For instance, turning of the threaded fastener **1750** may move the fastener **1750** up or down within the receiving tube **1742**. A weight **1740** connected to the fastener **1750** may then also move up and down with the threaded fastener **1750**. As further shown in FIGS. **17**A and **17**B, the receiving tube **1742** may have a window **1744** to allow one to see the weight **1740** in the tube **1742**. The weight(s) **1740** may be provided with indicia to the allow for easy determination of the particular weighting arrangement provided.

Although the above-described arrangements including a receiving tube generally illustrate an exterior of the receiving tube being exposed, the receiving tube may be enclosed within a rear portion of the golf club head without departing from the invention. For example, the interface area of the golf club head may completely enclose the receiving tube or some other structure to receive a weight member.

FIG. **18** illustrates yet another golf club head having a void **1802** formed in the rear and having adjustable weight members. The club head **1800** has the pair of spaced legs defining the void **1802** underneath the cover or crown portion of the club head. The golf club head **1800** includes two weight members **1840***a* and **1840***b*. The two weight members **1840***a*, **1840***b* may be arranged similar to the weights of FIGS. **16** and **17** such that one end may be heavier than another end. Further, the weight members **1840***a*, **1840***b* may be received in a receiving tube (not shown in FIG. **18**) similar to the arrangements above, or may be connected to an outer surface of the golf club head, as also described above.

The weight may be removed and flipped, rotated, etc. in order to adjust the overall weight arrangement of the golf club head **1800** and adjust the performance characteristics. In the arrangement of FIG. **18**, one weight **1840***a* is arranged to adjust weight in a fore/aft matter (e.g., toward the face/front, toward the rear) while the other weight **1840***b* is configured to adjust weight in a high/low matter (e.g., toward the top, toward the sole). Each weight may be adjusted independently of the other in order to customize the performance characteristics of the golf club head **1800**. Additional arrangements including weights that may be adjusted in a fore/aft and high/low manner will be discussed below. It is understood that the weights **1840***a*, **1850***a* may be switched such that the high/low weight member **1850** may be positioned towards the toe and the front/rear weight member **1840***a* may be positioned towards the heel. As further shown in FIG. **18**, the club head **1800** may have a channel **1850** extending across the sole of the club head **1850** from a heel to a toe and generally adjacent the ball striking face. The channel allows a certain amount of compression of the club head upon ball impact. This feature may cooperate with the other club head structures and weighting characteristics to further enhance performance of the club.

FIGS. **19**A and **19**B illustrate another alternative golf club head arrangement having a void **1902** formed in the rear of the golf club head **1900** and having an adjustable weight arranged within the void **1902**. Similar to the arrangements discussed above, the void **1902** provides ease of access to the adjustable weight arranged in the golf club head **1900**. The golf club head **1900** includes an open rear portion with a receiving tube **1942** extending from a sole of the golf club head **1900** toward a top of the golf club head **1900**. The club head **1900** has a sole surface **1930** extending from a base of the body proximate the ball striking face towards a rear of the club head body. The sole surface **1930** supports the end of the receiving tube **1942** at the sole. The cover or crown portion of the club head body extends past the sole surface **1930** wherein the sole surface **1930** would not be visible at an address position. Similar to the arrangements discussed above, the receiving tube **1942** may be configured to receive a weight **1940** that may have various weighting characteristics and may be adjustable, removable, rotatable, etc. to adjust the performance characteristics of the golf club head **1900**.

Due to the arrangement and location of the void **1902**, the weight **1940** may be visible through an open portion of the receiving tube **1942**, as shown in FIG. **19**B. This may permit a user to identify a position of the weight **1940** within the receiving tube **1942** and determine whether an adjustment of the weight is desirable. As with some arrangements discussed above, the weight **1940** may be held within the receiving tube **1942** via a fastener, such as a threaded fastener. The void **1902** may permit access to the fastener to adjust the weight **1940**.

Similar to the arrangements discussed above, the weight **1940** may have ends having different weight characteristics or may be formed of multiple portions that may permit adjustment of the weight distribution associated with the weight **1940**.

FIGS. **20**A and **20**B illustrate yet another golf club head arrangement having adjustable weights. The club head **2000** has the pair of spaced legs defining the void **2002** underneath the cover or crown portion of the club head **2000**. The weight arrangement shown includes two adjustable weights **2040***a*, **2040***b*, that are received in a first receiver and a second receiver or receptacles respectively. The adjustable weights **2040***a*, **2040***b* may have ends that are weighted differently and also be made from multiple weight members releasably connected together and having various weight values. In an exemplary embodiment, the first receiver is a first receiver tube **2042***a*, and the second receiver is a second receiver tube **2042***b*. The first receiver tube **2042***a* has a vertical configuration positioned proximate an interface area **2026**. The second receiver tube **2042***b* has a general horizontal configuration and extends from proximate the first receiver tube **2042***a* towards a rear of the club head **2000**. An end of the second receiver tube **2042***b* is connected at the rear periphery of the club head **2000**. While two weights are being shown, it is understood that more or fewer weights may be used as desired. Similar to the arrangements discussed above, the weights **2040***a*, **2040***b* may have one end heavier than another end or may be formed of multiple weight portions having different weight characteristics. It is understood that the first receiver tube **2042***a* may be completely encased at the interface area **2026**. As can be appreciated from FIGS. **20**A and **20**B, the second receiver tube **2042***b* extends along the void and has a space or gap defined between the tube **2042***a* and an underside surface of the cover or crown. An opening or open end into the second receiver tube **2042***b* is positioned proximate the rear of the club head **2000**. The second receiver tube **2042***b* has a closed end proximate the open end of the first receiver tube **2042***a*.

Similar to certain arrangements discussed above, the weights **2040***a*, **2040***b* are contained within the receiving tubes **2042***a*, **2042***b* in the golf club head **2000**. In some examples, the position of the weight **2040***a*, **2040***b* within the receiving tube may be maintained by a fastener, such as a screw or other threaded fastener. The receiving tube may be visible, such as receiving tube **2042***b* or may be contained within a portion of the golf club head **2000** such that it is not visible from an exterior of the club, such as the receiving tube **2042***a* associated with weight **2040***a*.

The weights **2040***a*, **2040***b* may be rotated, removed, adjusted, etc. to adjust the performance characteristics of the golf club head. For example, adjustment of weight **2040***b* may adjust the weight distribution of the golf club head in a front to rear direction. That is, positioning a heavier end of the weight **2040***b* near a front will adjust the overall weight of the club head **2000** toward a front or front face of the golf club. Alternatively, positioning a heavier end of the weight **2040***b* toward a rear of the golf club head **2000** may shift the overall weight of the club head **2000** toward the back or rear of the golf club head **2000**.

Weight **2040***a* may also be adjustable, removable, rotatable, etc. to adjust the overall weight characteristics of the golf club head **2000**. For instance, the weight **2040***a* may have a heavier end and a lighter end, as described above. As desired, the heavier end or lighter end may be inserted into the first receiving tube **2042***a* first to adjust the weight of the golf club in a high to low direction. That is, inserting the heavier end in first (e.g., toward the crown since the receiving tube is accessed from the sole of the golf club head) may move weight toward a crown of top of the golf club, while inserting the lighter end in first (e.g., toward the crown) will add more weight near the bottom or sole of the golf club.

The weights **2040***a*, **2040***b* may be adjusted independently of each other. Adjustment, rotation, etc. of the weights **2040***a*, **2040***b* may move or adjust the center of gravity of the golf club **2000** as desired. The hybrid arrangement of adjusting weight in both a fore/aft direction and high/low or sole/crown direction may provide for further customization of the weight and/or performance characteristics of the golf club head **2000**. It is also understood that the receivers could be supported by pivotable supports providing further adjustment capabilities. It is further understood that the receivers or receptacles have generally longitudinal axes. The weights are received along the longitudinal axes. In certain structures, the longitudinal axis is generally transverse to the ball striking face. In other structures, the longitudinal axis is generally parallel to the ball striking face. In still other structures, the longitudinal axis can be positioned at an angle with respect to the ball striking face.

FIG. **21** illustrates yet another golf club head arrangement. The club head **2100** has the pair of spaced legs defining a void **2102** underneath the cover or crown portion of the club head **2000**. The golf club head **2100** includes the void **2102** proximate the rear of the golf club head **2100** and extending towards the central region of the club head **2100**. In this embodiment, the void **2102** is formed by the first leg **2122** and the second leg **2124** that are spaced apart to help define the v-shaped void **2102**. In some examples, the legs **2122**, **2124** may include one or more sliding weights **2140** operably associated with the legs **2122**, **2124**. To this end, the weights **2140** may be supported by the legs **2122**, **2124** in different configurations. In one exemplary embodiment, the first leg **2122** may define a first passageway that receives a moveable weight **2140**, and the second leg **2124** may define a second passageway that receives a moveable weight **2140**. The passageways may be considered a track defined by the legs **2122**, **2124**. The sliding weights **2140** may be connected to the golf club head **2100** using screws **2165** or other fasteners that may permit adjustment of the position of the weights **2140**. For instance, a fastener **2165** positioned through the legs **2122**, **2124** may be received in a slot **2160** on the weight **2140** or other receiving recess positioned along a top of the weight **2140**. This cooperative configuration may allow for self-tightening upon rotation of the fastener **2165**. The fastener **2165** may maintain the position of the sliding weight **2140** within the leg. To adjust a position of the weight **2140**, the fastener **2165** may be loosened and the weights **2140** may be moved into (e.g., toward the front) or out of (e.g., toward the rear) the golf club head **2100** (as indicated by arrows) and the fastener **2165** may be retightened to secure the weight **2140** in the new or adjusted position. The void structure assists in providing the necessary access for adjustment of the weights **2140** along the legs. In an additional alternative arrangement, the legs could also define an internal floor wherein the weights **2140** could be supported by and slide along the floor. A fastener could be provided as a setting mechanism to secure the weight at a desired location along the leg. Additional track mechanisms may also be employed between the weights and the leg structures.

The slot **2160** arrangement may permit the weight **2140** to be secured in infinitely many positions along a length of the legs **2122**, **2124**. Additionally or alternatively, the slot **2160** may include one or more stops (not shown) which may define positions in which the weight **2140** may be secured and may aid in maintaining a position of the weight **2140**. The stops may take various forms and cooperate with the weight **2140** to maintain a position. In one exemplary embodiment, the stop may be a resiliently deflectable material, such rubber, polymer or other elastomeric material in order to maintain the

position of the weight in the slot, while permitting movement of the weight along the slot, e.g., by moving the weight over the stop causing the stop to deflect. In other exemplary embodiments, the moveable weight may cooperate with a biasing member to assist in maintaining a position of the weight. The weight may also be able to be changed out with other weights that are heavier or lighter.

In some examples, weights **2140** may have the same or substantially similar weight characteristics. In other examples, the weights **2140** may be different. Further, in some arrangements, the weights **2140** may be removable from the golf club head **2100** and, in some examples, replaced with other weights having different weight characteristics.

Adjustment of the weights **2140** will adjust the performance characteristics of the golf club head **2100**. For instance, as the weight is moved inward, toward a front face of the golf club head, the overall weight distribution of the golf club head **2100** will move forward, thereby adjusting the center of gravity of the golf club head **2100**. Alternatively, as the weights are adjusted outward, toward a rear of the golf club head **2100**, the center of gravity may be shifted toward the rear of the golf club head **2100**.

The weights may be adjusted independently of each other. For instance, one weight may be adjusted more forward than the other weight to further adjust the weight distribution, center of gravity, moment of inertia etc. of the golf club head **2100**. Further, the v-shaped configuration of the weights **2140** may provide a shift in weight in the fore/aft direction, as described above, but also in a toe/heel direction. In some examples, the weights **2140** may be arranged on an incline which may also result in a high/low weight adjustment when the weights **2140** are moved. The incline of the legs could also be structured to provide an increased combination of high/low and fore/aft weight movement. As further shown in FIG. **21**, the club head **2100** may have a channel **2150** extending across the sole of the club head **2100** from a heel to a toe and generally adjacent the ball striking face. The channel allows a certain amount of compression of the club head upon ball impact. This feature may cooperate with the other club head structures and weighting characteristics to further enhance performance of the club.

FIG. **22** illustrates another golf club head arrangement having a void **2202** formed in a rear of the golf club head **2200**. In some examples, the void **2202** may be substantially v-shaped and may include one or more adjustable weight assemblies **2240** positioned within the golf club head **2200** and along sidewalls **2204** of the v-shaped void **2202**. Although the arrangement of FIG. **22** includes two adjustable weight assemblies, more or fewer weight assemblies may be used without departing from the invention.

In some examples, the weights **2240** are supported by the legs and may be slidable along the sides **2204** of the void **2202**. For instance, a screw or other fastener **2265** may aid in maintaining a position of a weight within a slot **2260** arranged on the sidewalls **2204** of the void **2202**. As desired, the fastener **2265** may be loosened and adjusted along the slot **2260**, moving the weight fore (toward a face of the golf club head **2200**) or aft (toward a rear of the golf club head **2200**). Once a desired position is determined, the fasteners **2265** may be tightened to maintain the position of the weight along the slot **2260**.

In the arrangement shown, the weight may be positioned anywhere along slot **2260**. In an alternate arrangement, one or more stops may be arranged along the slot **2260** to aid in maintaining a position of the weight and to provide finite positions for the weight.

Similar to the arrangement discussed with respect to FIG. **21**, the weights may be adjusted along the slots and may move the weight distribution fore and/or aft, and may also adjust weight in a toe/heel direction due to the v-shaped void **2202** and sides **2204** of the void **2202** in which the weights are positioned. This may provide for customization of the weight distribution in multiple directions. Further, the weights may be adjusted independently of each other to further aid in customizing the overall weight distribution of the golf club head in order to adjust the performance characteristics of the golf club head **2200**. The weights may also be slidably mounted at various locations on the inner surfaces of the sidewalls **2204** including more towards an interface area at the convergence of the legs, or more towards the rear of the legs and also at various angles along the side walls **2204**. In other alternatives, the weights **2240** can be contained within an internal cavity of the club head but configured to be selectively slidable along internal surfaces of the legs. It is understood that the club head **2200** in FIG. **22** can be provided with a cover to extend over the void **2202** and/or the legs.

FIGS. **23**A-**23**C illustrate another golf club head arrangement **2300** having a void formed in the rear of the golf club head **2300** and having an adjustable weight arrangement configured therein. The golf club head **2300** includes an adjustable weight **2340** positioned within the void **2302** and accessible via the void **2302**. The weight **2340** may slide along a track extending from proximate a toe to proximate a heel. In some arrangements, some or all of the weight **2340** may be arranged within the golf club head **2300** and may not be visible from an exterior of the golf club head. Alternatively, the weight may be arranged on an outer surface of the golf club head **2300**, as desired.

In the arrangement of FIGS. **23**A-**23**C, a portion of the weight may be arranged on an interior of the golf club head **2300**. However, the weight may be adjusted from an exterior of the golf club head **2300**. For instance, the weight **2340** may be adjusted along a track or slot **2360** in order to shift the weight associated with the golf club head from proximate the toe to proximate the heel or vice versa. Although the slot is shown as being curved or arced, various slot arrangements may be used without departing from the invention. For instance, the slot may be generally linear, v-shaped, etc.

Similar to the arrangement described above, the weight **2340** may be threaded or may be adjustable via a threaded fastener and may be maintained in positioned via the threads. In some arrangements, the weight **2340** may have varying shapes and may be held in place via a threaded fastener extending through the slot.

FIG. **23**B illustrates a cover **2350** that may extend over a portion of the rear of the golf club head to cover the weight **2340** and slot **2360**. The cover may provide a more conventional appearance for the golf club head **2300** and may prevent dirt, debris, etc. from entering the golf club head **2300** via the slot **2360**.

FIG. **23**C illustrates the golf club head **2300** with the cover removed. As shown, the rear of the golf club head **2300** is generally open and has a substantially planar structure. This open rear structure may aid in reducing overall weight associated with the golf club head **2300**. The addition of the cover **2350** may provide the advantage of a golf club head having reduced weight while maintaining the appearance of a conventional golf club head.

FIGS. **24**A and **24**B illustrate an arrangement similar to FIGS. **23**A-**23**C including an adjustable weight **2440** that is adjustable along a slot or track **2460**. As shown in FIG. **24**B, the weight **2440** may have two ends having different weight characteristics. Thus, as the weight **2440** is adjusted along a

length of the slot **2460**, the weight distribution in a toe/heel direction may be altered, as well as in a high/low direction. The golf club head **2400** may further include a second slot **2470** that may allow for adjustment of another weight (not shown). The club head structure having the void provides for easy access to the weight **2440**.

FIGS. **25**A and **25**B illustrate another golf club head **2500** having a void **2502** formed in the rear of the golf club head and having adjustable weights arranged therein (e.g., along the walls of the void **2502**). The golf club head **2500** includes two adjustable weights **2540** arranged along a sidewall of the v-shaped void **2502**. More or fewer weights may be used without departing from the invention. In some examples, a portion of the weight **2540** may be arranged within an interior of the golf club head **2500**, while a portion may be accessible from the exterior of the golf club head **2500**. That may aid in ease of adjustment of the weights **2540**.

In some arrangements, the weights **2540** may be slidable, e.g., along a track or slot **2560**. For instance, the weights **2540** may have a first position near a base of the v-shaped void **2502** and proximal a front of the golf club head **2500**. The weights **2540** may slide outward, from the first position, toward the rear corners of the golf club head **2500** to adjust the overall weight distribution of the golf club head **2500**. In some examples, the weights **2540** may be held in place via friction fits, etc. In other examples, one or more stops may be arranged along the slots **2560** and may maintain the position of the weights **2540** until a force exceeding a certain threshold is applied to the weight **2540** and it may be moved beyond the stop. Although the slot **2560** shown is generally linear, the slot may be curved, arced, etc. without departing from the invention.

In some arrangements, the weights may have the same or substantially similar weights or weight characteristics. Alternatively, the weights **2540** may have different weight characteristics. Further, the weights may, in some examples, be adjusted together. For instance, the movement of one weight **2540** along the slot **2560** may also cause a corresponding movement of the other weight **2540** along the slot **2560**. Alternatively, the weights **2540** may move independently of each other. The weights **2560** may be secured via friction fits or other mechanical configurations.

FIG. **26** illustrate another example golf club head **2600** having a void **2602** formed in the rear of the golf club head **2600**. A bottom cover **2643** may be used to cover one or more of the adjustable weight arrangements discussed herein. In addition, the golf club head **2600** may include a channel **2650** that further provides performance enhancements to the golf club head **2600** as described above.

FIGS. **27**A and **27**B illustrate another example golf club head **2700** having a void and including an adjustable weight **2740**. It is understood that a cover to be positioned over the void is not shown in FIG. **27**A. Similar to the arrangements discussed above, a portion of the weight may be internal to the golf club head **2700**, while a portion of the weight **2740** may be accessible from an exterior of the golf club head. The weight **2740** may be adjustable along a slot or track **2760**. In some examples, the weight **2740** may be maintained in position along the slot or track **2760** using a fastener, such as a threaded fastener, that may be loosened to allow for adjustment of the weight **2740**. In other examples, the weight **2740** may be held in position using friction fits. In still other examples, one or more stops may be arranged along the slot or track to maintain a position of the weight **2740** until a threshold force is applied to move the weight past the stop.

The weight **2740** may be adjusted up toward the top or crown of the golf club head, or down toward the sole of the golf club head **2700**. In some examples, the slot or track **2760** may be inclined (e.g., slanting upward as it extends from the rear toward the front of the golf club head). This inclined slot arrangement may permit adjustment of the weight in both a high/low direction, as well as in a fore/aft direction. FIG. **27**B illustrates an interior of the golf club head **2700** as seen from the toe end. The weight **2740** is movable as indicated by the arrow. Thus, in one aspect, the weight is moveable along the track between a position proximate the sole and a position proximate the cover or crown. Movement of the weight will adjust the weight of the club both in the high/low direction (e.g, from crown to sole and vice versa) and the fore/aft direction (e.g., from front to rear and vice versa). Movement of the weight may adjust the overall weight distribution of the golf club head **2700**, as well as affect the center of gravity and moment of inertia characteristics of the golf club head.

As can be appreciated from FIG. **27**B, a cover member may be used to cover the adjustable weight **2740**. The cover may aid in preventing dirt and debris from entering the slot or track **2760**. However, the void **2702** formed in the rear of the golf club head **2700** may still provide ease of access to the adjustable weight **2740** when the cover is removed.

FIG. **28** illustrates another adjustable weight arrangement. Similar to some arrangements discussed above, the weight **2840** may be adjustable along track **2841** to move the weight toward the toe or the heel of the golf club head in order to adjust the performance characteristics of the golf club head **2800**. The club head **2800** has a void formed therein and it is understood that a cover could be provided to be positioned over the void and weight.

FIGS. **29-44** disclose additional embodiments of the club head according to aspects of the present invention. In particular, FIGS. **29-35** disclose an embodiment of the golf club head according to at least some aspects of the invention, generally designated with the reference numeral **3000**. The golf club head **3000** generally includes a golf club head body **3002** and a cover **3004**. In this particular embodiment, the cover **3004** is formed as an integral portion of the club head body **3002**, such as from a casting manufacturing process. Similar to previous embodiments, the golf club head **3000** has a geometric weighting feature associated therewith. The golf club head **3000** generally has a front or ball striking face **3008**, a rear **3010**, a top **3012** or crown **3012**, a sole **3014**, a heel **3016**, and a toe **3018**. It is further understood that the golf club head body **3002** defines an internal cavity **3019**.

As shown in FIGS. **29-35**, the golf club head body **3002** has a base member **3020** and a first leg **3022** and a second leg **3024**. As the club head body **3002** is generally an integral structure in this embodiment, the base member **3020** and legs **3022**, **3024** may be considered to depend from the cover **3004**. The base member **3020** generally extends from the heel **3016** to the toe **3018** and defines the ball striking face **3008** on one side. The base member **3020** assists in defining a portion of the internal cavity **3019** and in an exemplary embodiment, the internal cavity **3019** extends from an inner surface of the ball striking face **3008** and into the end of the internal areas defined by the legs **3022**, **3024** and cover **3064**. As can be appreciated from the drawings, the inner surface of the ball striking face **3008** faces into the internal cavity **3019** and is further in communication with portions of the internal cavity **3019** defined by the first leg **3022** and the second leg **3024**. The ball striking face **3008** may utilize a variable face construction as described above and be separately connected to the club head body **3002**. As shown in FIGS. **33-34**, the first leg **3022** extends away from the ball striking face **3008**, and the second leg **3024** extends away from the ball striking face **3008**. The first leg **3022** and the second leg **3024** extend

respectively towards the rear of the club at the heel **3016** and toe **3018** of the club head **3000**. In an exemplary embodiment, the legs **3022**, **3024** extend consistently from the interface area **3028** towards the rear at the heel **3016** and the toe **3018**. Thus, the legs **3022**, **3024** extend continuously from the interface area **3028** outwardly towards the heel **3016** and toe **3018** of the club head **3000**, and generally in a linear configuration. The legs **3022**, **3024** could extend in a non-linear configuration. The legs **3022**, **3024** could also extend at different lengths if to achieve further weight distribution and performance characteristics.

The club head **3000** utilizes the geometric weighting feature and in an exemplary embodiment, a void **3026**, or space or gap, is defined between the first leg **3022** and the second leg **3024**. Thus, it may be considered that this portion of the golf club head is removed to form or define the void **3026**. In a further exemplary embodiment the void **3026** is generally v-shaped. Thus, the first leg **3022** and second leg **3024** converge towards one another and generally meet at an interface area **3028**. The void **3026** has a wider dimension at the rear **3010** of the club head **3000** and a more narrow dimension proximate a central region of the club head generally at the interface area **3028**. The void **3026** opens to the rear **3010** of the club head **3000**. In one exemplary embodiment, the interface area **3028** has a height and is positioned proximate a central portion or region of the body **3002** and defines a base support wall **3030**. The base support wall **3030** may have a rounded surface that faces into the void **3026**. A proximal end of the first wall **3022** connects to one end of the base support wall **3030**, and a proximal end of the second wall **3024** connects to another end of the base support wall **3030**. It is understood from the figures that the base support wall **3030** can extend between the sole surface and the underside of the cover **3004** in a general vertical configuration. In an exemplary embodiment, the base support wall **3030** extends from the sole surface at an angle from a vertical axis. Thus, the base support wall **3030** could extend along its length towards the rear of the club head or towards the ball striking face. The base support wall **3030** may meet a sole surface of the golf club head **3000** to define a ridge location. An angle A is defined between the legs **3022**, **3024** which angle can vary in degree, including a right angle, acute angles or obtuse angles. In one exemplary embodiment, the angle A can be in the general range of 30 degrees to 110 degrees, and more specifically 45 degrees to 90 degrees. It is further understood that the angle A can change from a location proximate the sole to a location proximate an underside of the cover or crown. The angle A could also change along the length of the legs **3022**, **3024**. The legs **3022**, **3024** could also extend from the interface area **3028** at different angles in a non-symmetrical fashion to provide desired performance characteristics. It is further understood that the void **3026** and also the legs **3022**, **3024** could be positioned in a rotated configuration about the central region such as rotated more towards the rear heel of the club head or rotated more towards the rear toe of the club head. It is also understood that the interface area **3028** could be positioned at various locations between the heel and toe and the golf club head. While a v-shaped void **3026** is formed, the void **3026** could take other forms including a more u-shaped defined void wherein the interface area **3028** defines a more extended base support wall **3030** that separates the legs **3022**, **3024**, even if the legs **3022**, **3024** extend at an angle or are generally transverse to the ball striking face **3008**. It is understood that the base support wall **3030** can vary in width.

With such structures, it is understood that the internal cavity **3019** does not extend completely from an inner surface of the ball striking face to a rear of the golf club head. Thus, the internal cavity is interrupted proximate the central region of the club head **3000**. It is further understood that the geometric weighting feature described herein is generally v-shaped wherein a width of the geometric weighting feature proximate the rear is greater than a width of the geometric weighting feature towards the ball striking face.

As further shown in FIGS. **33-34**, the first leg **3022** defines a first external side surface **3032** and the second leg **3024** defines a second external side surface **3034**. Each side surface **3032**, **3034** has a proximal end **3036** positioned at the interface area **3028** and further has a distal end **3038** at the rear **3010** of the club **3000**. In an exemplary embodiment, the distal ends **3038** extend inwards from the majority portion of the side surfaces **3032**, **3034**. As can be appreciated from FIG. **33**, inwardly extending the distal ends **3038** of the side surfaces **3032**, **3034** shortens the arc of the rear of the club head between the distal ends **3038**. This can have a desired effect on the sound characteristics of the golf club head **3000**. In still other exemplary embodiments, such desired effects may prompt the distal ends **3039** to extend outward therefore lengthening the arc of the rear between the distal ends **3038**. The respective heights of the distal ends **3038** further decrease towards the rear **3010** of the club head **3000**. As further shown in FIG. **33**, the side surfaces **3032**, **3034** have a greater height at the proximal ends **3036** wherein the surfaces extend to a lesser height towards the distal ends **3038**. For example, in one exemplary embodiment for a driver type golf club head, the height of the side surfaces **3032**, **3034** at the proximal ends **3036** from an underside of the cover **3004** to the sole of the club head proximate the base support wall **3030** is approximately 48-62 millimeters. This height can be considered the depth of the void **3026** proximate the interface area **3028**. In one particular driver type golf club head, this height is approximately 52 millimeters while the ball striking face height at a face center of the golf club head is approximately 58 millimeters. In another particular driver type golf club head, this height is approximately 60 millimeters and the ball striking face height at a face center is approximately 62 millimeters. In a fairway type golf club head, this height is approximately 33 millimeters and the ball striking face height at a face center is approximately 35 millimeters. In a hybrid type golf club head, this height is approximately 33 millimeters and the ball striking face height at a face center is approximately 38 millimeters. Generally, this height may be approximately 85%-100% of the ball striking face height at a face center of the golf club head. Such configurations allow the cover or crown geometry to be dimensioned such that the desired performance characteristics of the club head are achieved. The height of the side surfaces **3032**, **3034** proximate the distal ends from an underside of the cover **3004** to the sole is generally less at the distal ends **3028**.

In one exemplary embodiment, the side surfaces **3032**, **3034** each have a plurality of ribs **3040** or ridges extending from the proximal ends **3036** towards the distal ends **3038**. Thus, the side surfaces **3032**, **3034** have a stepped configuration or undulations. Such structures assist in adding a certain amount of rigidity to the body **3002**. It is understood that a single rib **3040** could be used and only a single leg **3022**, **3024** could have a rib **3040**. Other rigidity-enforcing structures could also be employed on the legs **3022**, **3024** or other portions of the golf club head **3000**. It is further understood that in exemplary embodiments, the first leg **3022** is generally defined by the first side surface **3032** and the club head body forming the heel of the club head **3000**, and the second leg **3024** is generally defined by the second side surface **3024** and the club head body forming the toe of the club head **3000**. As can be appreciated from the figures, the sole **3014** of the club

head body **3002** may be defined as adjacent the ball striking face **3008**, towards the central region of the club head at the interface area **3028** and to the distal ends of the first leg **3022** and the second leg **3024**.

The club head body **3002** defines additional internal support structures in the internal cavity **3019** to enhance features of the club head **3000**. The structures may be internal support members, gussets, or fins, positioned in the internal cavity **3019** to provide additional support to components of the club head **3000**. Accordingly, as shown in FIG. **35**, the club head **3000** includes a first gusset member **3050** and a second gusset member **3052**. In an exemplary embodiment, the first gusset member **3050** and the second gusset member **3052** are triangle-shaped members, and generally right triangle members in particular, although it is understood that the gussets **3050**, **3052** can have certain contoured outer sides. The gussets **3050**, **3052** may have a constant or variable thickness. The first gusset member **3050** is positioned proximate an internal surface of the first leg **3022** and an internal surface of the interface area **3028**. The second gusset member **3052** is positioned proximate an internal surface of the second leg **3024** and an internal surface of the interface area **3028**. The first gusset member **3050** is in spaced relation to the second gusset member **3052**. In particular, the first gusset member **3050** has one side, or first side, connected proximate a first interface junction **3054** of the base support wall **3030** and the first leg **3022**, and has a bottom side, or second side, connected to an internal sole surface **3058**. Similarly, the second gusset member **3052** has one side, or first side, connected proximate a second interface junction **3056** of the base support wall **3030** and the second leg **3024**, and has a bottom side, or second side, connected to the internal sole surface **3058**. The gusset members **3050**, **3052** generally extend from the base support wall **3030** towards the ball striking face **3008**. It is understood that the gusset members **3050**, **3052** can be moved inwards and connected on the inner surface of the base support wall **3030**. As further shown in FIG. **35**, the gusset members **3050**, **3052** extend upwards on a portion of the base support wall **3030** at the interface area **3028**. This distance can vary and may or may not extend fully to an underside surface of the cover of the club head **3000**. Similarly, the gusset members **3050**, **3052** are dimensioned to extend along a portion of the internal sole surface **3058**, which distance can also vary. FIGS. **35***a* and **35***b* show additional views of the gusset members **3050**, **3052**. In an exemplary embodiment, the gusset members **3050**, **3052** diverge on the internal sole surface **3058** as shown by the arrows in FIG. **35** as the members extend towards the ball striking face **3008**. As shown in FIG. **35***a*, it is understood that the gusset members **3050**, **3052** may extend vertically up the surface of the base support wall **3030** at an angle. It is further understood that additional support members could be connected between the gusset members **3050**, **3052** as desired. It has been determined that based on the particular construction of the club head **3000**, upon ball impact, portions of the club head **3000** can flex, such as at the interface area **3028**. Sound upon ball impact is also affected with the particular construction of the golf club head **3000**.

The first gusset member **3050** and the second gusset member **3052** assist in adding stiffness, rigidity and load strength at the interface area **3028** and limits flexing as desired to provide the desired performance characteristics including acoustic properties. Increased durability is also achieved. The gusset members **3050**, **3052** do not add significant additional weight to the golf club head **3000**. With such constructions, weight distribution can be further maximized to be moved towards the rear at the heel **3016** and the toe **3018**. The configuration of the void **3026** can then also be maximized. These constructions further adjust sound characteristics of the golf club head **3000** upon ball impact to desired frequency levels. It is noted that the sole surface is generally solid at locations where the gusset members engage and extend along the inner surface of the sole. Thus, no other weight port structures are positioned at the gusset members in an exemplary embodiment.

It is understood that additional gusset members could be utilized if desired or gusset members having different configurations than shown could also be utilized. For example, multiple gusset support members could span around different locations at the interface area or inner surfaces of the first leg and second leg. The gusset members **3050**, **3052** could also be connected at the internal surfaces of the legs rather than at the interface junctions **3054**, **3056**. The gusset members could also extend to and be connected to other internal surfaces of the club head. In addition, the gusset members **3050**, **3052** could be dimensioned to extend across the interface face area **3028** and against the internal surfaces of the legs **3022**, **3024** towards the rear of the golf club head **3000**. The gusset members **3050**, **3052** are metallic members in one exemplary embodiment but other materials are possible including composite materials. It is further understood that the gusset support members could be cast or otherwise integrally formed with the club head body in the same forming process. The gusset support members can also be formed separately and later connected as described above such as by welding, adhesives or other connection techniques. While the gusset members are shown as triangular members in one exemplary embodiment, the gusset members could take many different shapes and sizes. The gusset members could further have certain cut-out portions or contours as desired.

As further shown in FIG. **34**, the interface area **3028** is positioned at generally a central portion or central region of the club head **3000** between the ball striking face and rear of the golf club head **3000**. The club head **3000** has a breadth dimension B generally defined as a distance from the ball striking face **3008** to the rear **3010** of the club **3000**. (See, e.g. FIG. **1**B). As further shown in FIGS. **36-38**, the base support wall **3030** of the interface area **3028**, proximate the sole surface, is positioned at approximately "x" distance from the ball striking face **3008**. Alternatively, the base support wall **3030** of the interface area **3028**, proximate the sole surface, is positioned at approximately "y" distance from the rear **3010** of the golf club head **3000**. Considered in an alternative fashion, the interface area **3028** may be positioned at a range of approximately 30%-60% of the breadth B of the club **3000**, measured from the ball striking face **3008**, or 40%-70% of the breadth B of the club **3000**, measured from the ball striking face **3008**. In a further exemplary embodiment, this range can be approximately 40%-50% of the breadth B of the club **3000**, measured from the ball striking face **3008**, or 40%-60% of the breadth B of the club **3000**, measured from the ball striking face **3008**. In one exemplary embodiment for a driver type club, the overall breadth is approximately 4.365 inches and the distance from the ball striking face to the support wall is approximately 1.875 inches. In another exemplary embodiment for a driver type club, the overall breadth is approximately 4.45 inches and the distance from the ball striking face to the support wall is approximately 2.6 inches. In one exemplary embodiment for a fairway wood type golf club, the overall breadth is approximately 3.375 inches and the distance from the ball striking face to the support wall is approximately 1.5 inches. In another exemplary embodiment for a fairway wood type golf club, the overall breadth is approximately 3.375 inches and the distance from the ball striking face to the support wall is approximately 1.7 inches. In one

exemplary embodiment for a hybrid type golf club, the overall breadth is approximately 2.375 inches and the distance from the ball striking face to the support wall is approximately 1.125 inches. In another exemplary embodiment for a hybrid type golf club, the overall breadth is approximately 2.375 inches and the distance from the ball striking face to the support wall is approximately 1.25 inches. From these recited dimensions, the distance y from the rear of the club to the base support wall can be readily determined. It has been found that these dimensions can further have an effect on the club head body flexing upon ball impact and effect the sound characteristics desired for the golf club head **3000**. FIGS. **36-38** disclose further alternative embodiments of the golf club head **3000**. As shown in FIG. **36**, the base support wall **3030** and interface area **3028** are positioned closer to the ball striking face **3008**. In FIGS. **37** and **38**, the base support wall **3030** and interface areas **3028** are positioned further away from the ball striking face **3008** and closer towards the rear **3010** of the club head **3000**. Thus, these embodiments can be utilized depending on the desired characteristics of the club head.

As further shown in FIGS. **33-34**, it is understood that the outer, bottom surfaces of the base **3020** and legs **3022**, **3024** generally define the sole of the club head **3000**. It is further understood that the length of the base **3020** from the ball striking face **3008** to the interface area **3028** could vary as desired. The first leg and/or base has a first recessed area **3060** proximate the heel **3016** of the club head **3000**, and the second leg and/or base has a second recessed area **3062** proximate the toe **3018** of the club head **3000**. The first recessed area **3060** is further in communication with a bore **3064**. The bore **3064** is dimensioned to receive a releasable adjustable connection mechanism for connecting the shaft to the club head **3000** such as via the hosel **104**. It is understood that the connection mechanism may be configured to have the ability to adjust loft, face angle and/or lie angle. It is further understood that the connection mechanism could take various different forms and also form a non-adjustable connection that merely connects the shaft to the golf club head in a non-adjustable manner.

FIGS. **29-34** disclose the cover **3004**. As discussed, in this embodiment, the cover **3004** is integrally formed as a portion of the club head body **3002** and generally defines the crown **3012** of the club head **3000**. The cover **3004** is configured to be connected to and at least cover portions of the club head body **3002**. The cover **3004** may have a certain amount of curvature on an outer, top surface. In the exemplary embodiment shown in FIGS. **29-34**, the cover **3004** is dimensioned to substantially cover the club head body **3002**.

The cover **3004** will cover the void **3026** as well as the first leg **3022** and second leg **3024**. The first leg **3022** and the second leg **3024** may be considered to depend from the cover **3004**. With such construction, and as shown generally schematically in FIG. **30**, a first segment **3070** of the cover **3004** may be considered to be positioned over the internal cavity **3019**, and a second segment **3072** of the cover **3004** may be considered to be positioned over the void **3026**. The surface area of the first segment **3070** is generally greater than the surface area of the second segment **3072** in an exemplary embodiment. The cover **3004** has a curved outer periphery at a rear that extends over and to just beyond the distal ends of the first leg **3022** and the second leg **3024**. In certain exemplary embodiments, the cover **3004** defines the rear of the club having an outermost periphery of the club head. If the club head body **3002** is formed with a recess as discussed above, peripheral portions of the cover **3004** are dimensioned to correspond with the shape of the recess on the club head body **3002**. An underside surface of the cover **3004** confronts and is in communication with the void **3026**. In addition to sensor mountings as shown in other embodiments, other structures could be mounted on this surface. An underside of the cover facing into the void may have a plaque member adhered thereto via adhesive. The plaque has sufficient rigidity and the adhesive has sufficient resilience to promote a durable bond and vibration dampening characteristics. The plaque materials may be fiber-reinforcement plastics, metals, plastics and the like. The adhesives could be epoxies, silicone adhesives or 3M VHB double-sided tape. The plaque could also have indicia thereon facing into the void. As discussed, the cover could wrap around the sole surface side the golf club to completely encase the void **3026** wherein the void **3026** is not seen from a top or a bottom of the club head. In an exemplary embodiment, however, the cover **3004** extends over the void **3026** and legs **3022**, **3024** wherein at an address position; the golf club head **3000** has the appearance of a traditional golf club head and wherein the void **3026** is not visible.

As further shown in FIGS. **29-35**, the cover **3004** is integrally formed as a portion of the club head body **3002**. In one exemplary embodiment, the club head body **3002** is formed in a casting manufacturing process. In a further exemplary embodiment, the club head body **3002** is cast entirely from titanium. It is understood that other metal materials could be used, or composite materials, or plastic injection molded materials or a combination thereof. With certain materials, additional coating processes may also be used to add additional strength. It is also understood that the ball striking face **3008** is separately connected to the golf club head body **3002**, such as in a welding operation. It is further understood that alternative connection mechanisms between the body **3002** and the cover **3004** can also be employed if an integral connection is not employed. The cover **3004** and the club head body **3002** may be connected, joined, fastened or otherwise fixed together (directly or indirectly through intermediate members) via adhesives, cements, welding, soldering or other boding or finishing techniques; by mechanical connectors (such as threads, screws, nuts, bolts or other connectors); interference fits and the like. As can be appreciated, the cover **3004** may be considered to generally form the crown of the club head **3000**. Remaining portions of the club head body **3002** define the ball striking surface and the depending legs spaced apart to define the void underneath the cover.

It is understood that the structures of the golf club head **3000** described herein cooperate to form a club head having enhanced characteristics. The void construction provides the ability to distribute weight more towards the rear at the heel and toe. In further exemplary embodiments, the club head **3000** could be structured wherein wall thicknesses of the first leg and second leg can be increased in the manufacturing process to further increase weight towards the rear at the toe and the heel. Wall thicknesses at the distal ends of the legs can be increased to add weight at the rear at the toe and heel. It is further understood that weight members can be internally supported in the legs. Additional structures such as the gusset members provide for the desired amount of rigidity and flexing. The resulting club head provides enhanced performance and sound characteristics.

FIGS. **39-44** disclose another embodiment of the club head according to at least some aspects of the invention, and the club head is also generally designated with the reference numeral **3000**. Because of the similarities in structure to the embodiment of the club head shown in FIGS. **29-35**, the additional features and differences will be described with the understanding that the above description is applicable to the club head **3000** shown in FIGS. **39-44**. In this embodiment, the golf club head **3002** includes a receptacle, or a weight port

3070 on a sole surface of the club head **3000**. The weight port **3070** is positioned proximate the interface area **3028** and in particular, at the base support wall **3030** adjacent the void **3026**. The weight port **3070** may have internal threads or other further connection structure. A weight member **3072** is provided and may have multiple parts, outer threads or other connection mechanisms. The weight member **3072** may have a certain weight value and may be secured in the weight port **3070**. The weight member **3072** may comprise multiple parts connected together to allow adjustability of weight. Using the weight member **3072** in the weight port **3070** allows the golfer to customize the swing weight of the golf club as desired. It is understood that internal support members or gussets are not utilized in this embodiment although such structures could be incorporated if desired.

Several different embodiments of the golf club head of the present invention have been described herein. The various embodiments have several different features and structures providing benefits and enhanced performance characteristics. It is understood that any of the various features and structures may be combined to form a particular club head of the present invention.

The structures of the golf club heads disclosed herein provide several benefits. The unique geometry of the golf club head provides for beneficial changes in mass properties of the golf club head. The geometric weighting feature provides for reduced weight and/or improved weight redistribution. The void defined in the club head can reduce overall weight as material is removed from a conventional golf club head wherein a void is defined in place of such material that would normally be present. The void also aids in distributing weight throughout the club head to order to provide improved performance characteristics. The void provides for distributing weight to the rear corners of the club head, at the toe and the heel. Increases in moment of inertia have been achieved while optimizing the location of the center of gravity of the club head. This can provide a more forgiving golf club head as well as a golf club head that can provide more easily lofted golf shots. In certain exemplary embodiments, the weight associated with the portion of the golf club head removed to form the void may be approximately 4-15 grams and more particularly, 8-9 grams. In other exemplary embodiments, this weight savings may be redistributed to other areas of the club head such as towards the rear at the toe and the heel. In certain exemplary embodiments, approximately 2% to 7.5% of the weight is redistributed from a more traditional golf club head design. In still further examples, the void may be considered to have a volume defined by an imaginary plane extending from the sole surfaces and rear of the club and to cooperate with the side surfaces of the legs and underside portion of the cover. The internal cavity may also have a certain volume. The volumes are dimensioned to influence desired performance characteristics. It is further understood that certain portions of the club head can be formed from alternative materials to provide for weight savings or other weight redistribution. In one exemplary embodiment, the walls defining the void may be made from other materials such as composites or polymer based materials.

As discussed, the weight can be redistributed to more desired locations of the club head for enhanced performance. For example, with the centrally-located void and the legs extending outwardly towards the rear on the heel side and the toe side, more weight is located at such areas. This provides more desired moment of inertia properties. In the designs described herein, the moment of inertia (MOI) about a vertical axis (z-axis) through the center of gravity of the club head (Izz) can range from approximately 1500 gm-cm^2 to 5900 gm-cm^2 depending on the type of golf club. In an exemplary embodiment for a driver type golf club, the moment of inertia about a vertical axis (z-axis) through the center of gravity of the club head (Izz) can range from approximately 3800 gm-cm^2 to 5900 gm-cm^2, and in a further exemplary embodiment, the Izz moment of inertia can range from 4300 gm-cm^2 to 5200 gm-cm^2. In an exemplary embodiment of a fairway wood type golf club, the moment of inertia about a vertical axis (z-axis) through the center of gravity of the club head (Izz) can range from approximately 2000 gm-cm^2 to 3500 gm-cm^2, and in a further exemplary embodiment, the Izz moment of inertia can range from 2200 gm-cm^2 to 3000 gm-cm^2. In an exemplary embodiment of a hybrid type golf club, the moment of inertia about a vertical axis (z-axis) through the center of gravity of the club head (Izz) can range from approximately 2000 gm-cm^2 to 3500 gm-cm^2, and in a further exemplary embodiment, the Izz moment of inertia can range from 2200 gm-cm^2 to 3000 gm-cm^2, and in a further exemplary embodiment, the Izz moment of inertial can range from 1800 gm-cm^2 to 2800 gm-cm^2. In a particular embodiment utilizing the adjustable connection mechanism in the hosel, the Izz moment of inertia is approximately 4400 gm-cm^2 to 4700 gm-cm^2. These values can vary. With such moment of inertia properties, improved ball distance can be achieved on center hits. Also, with such moment of inertia properties, the club head has more resistance to twisting on off-center hits wherein less distance is lost and tighter ball dispersion is still achieved. Thus, a more forgiving club head design is achieved. As a result, golfers can feel more confident with increasing their golf club swing speed.

In addition, the center of gravity of the club head is positioned at a location to enhance performance. In the structures of the exemplary embodiments of the golf club head, the center of gravity is positioned outside of the void location of the club head, and inside the internal cavity or internal volume of the club head. In certain exemplary embodiments, the center of gravity is located between an inner surface of the ball striking face and an inner surface of the base support wall, or within the internal cavity.

In addition, the geometry and structure of the golf club head provides enhanced sound characteristics. With the structure of the crown, geometric weighting feature as well as the internal support members as described above such as in FIGS. **29-44**, it has been determined that the first natural frequency of the golf club head, other than the six rigid body modes of the golf club head, is in the range of 2750-3200 Hz. In additional exemplary embodiments, the first natural frequency of the golf club head is at least 3000 Hz. It has been found that golf club head structures providing such a frequency of less than 2500 Hz tend to be displeasing to the user by providing undesirable feel including sound and/or tactical feedback. The structures provided herein provide for increased frequencies at more desirable levels.

In addition, the moveable weight mechanisms employed herein provide additional options for distributing weight providing further adjustability of moment of inertia and center of gravity properties. For example, embodiments described herein providing weights that can be further moved towards the rear of the club head at the heel and toe can provide more easily lofted golf shots. Weights can also be more towards the front of the club head to provide more boring shots, such as those desired in higher wind conditions. Weights can also be positioned more towards a crown or sole of the golf club head in certain embodiments. Such moveable weighting features provide additional customization. Finally, adjustable connection mechanisms can be used with the club heads to provide club head adjustability regarding face angle, loft angle and/or

lie angle. Such adjustable connection mechanisms are disclosed, for example, in U.S. Ser. Nos. 61/577,660 and 61/526,325, which applications are incorporated by reference herein. Other adjustable mechanisms could also be used. A further embodiment utilizing the adjustable connection mechanism described above allows the golfer to adjust parameters of the golf club such as loft angle of the golf club. Certain golfers desire a lower loft angle setting such as but not limited to 7.5 degrees, 8 degrees, or 8.5 degrees or even 9 degrees. Such low loft angle settings may provide lower ball spin at ball impact. The moveable weight mechanisms, such as shown in FIGS. **17-20** could be utilized to place a heavier weight low towards a sole of the golf club head. This weighting configuration can provide for increased ball spin at the low loft angle settings. Certain other golfers may desire a higher loft setting such as but not limited to 11 degrees, 11.5 degrees, 12 degrees or 12.5 degrees. Such high loft angle settings may provide higher ball spin at ball impact. The moveable weight mechanism could be utilized to place a heavier weight high towards the top of the golf club head. This weighting configuration can provide for reduced ball spin at the high loft angle settings. Additional moveable weight mechanisms such as provided in FIGS. **20**A-**20**B could provide combinations of high/low and fore/aft weighting configurations to affect performance characteristics and provide particular desired launch conditions at particular loft angle settings.

Thus, while there have been shown, described, and pointed out fundamental novel features of various embodiments, it will be understood that various omissions, substitutions, and changes in the form and details of the devices illustrated, and in their operation, may be made by those skilled in the art without departing from the spirit and scope of the invention. For example, it is expressly intended that all combinations of those elements and/or steps which perform substantially the same function, in substantially the same way, to achieve the same results are within the scope of the invention. Substitutions of elements from one described embodiment to another are also fully intended and contemplated. It is the intention, therefore, to be limited only as indicated by the scope of the claims appended hereto.

What is claimed is:

1. A golf club head comprising:

a body defining a ball striking face, the body further having a first leg extending away from the ball striking face and a second leg extending away from the ball striking face wherein a void is defined between the first leg and the second leg, and further defining an interface area proximate the first leg and the second leg, the body further having a cover that extends over the void; and

a weight operably associated with the interface area;

wherein the body defines a receiver at the interface area, the weight being received in the receiver;

wherein the receiver comprises a first receiver tube, the tube having a closed end proximate the cover and an open end proximate a sole of the body; and

wherein the weight has a first end and a second end, the first end being heavier than the second end, the weight having a first position wherein the first end is positioned at the closed end and a second position wherein the second end is positioned at the closed end.

2. The golf club head of claim **1** wherein the weight is moveable between a first position providing a first weight arrangement and a second position providing a second weight arrangement.

3. The golf club head of claim **1** wherein the weight is moveable among a plurality of positions, each position providing a corresponding weight arrangement.

4. The golf club head of claim **1** wherein the weight comprises a first weight and a second weight, each weight being moveable between a first position providing a first weight arrangement and a second position providing a second weigh arrangement.

5. The golf club head of claim **1** wherein the weight is moveable between a first position towards the cover and a second position away from the cover.

6. The golf club head of claim **1** wherein the weight is dimensioned to be received in the tube through the open end.

7. The golf club head of claim **1** wherein the weight comprises a plurality of weight members releasably connected together.

8. The golf club head of claim **7** wherein the weight members have different weight values.

9. The golf club head of claim **1** further comprising a second receiver tube supported by the body, the second receiver tube having a closed end proximate the open end of the first receiver tube, the second receiver tube further having an open end proximate a rear of the club, and a second weight received in the second receiver tube.

10. The golf club head of claim **9** wherein the second weight has a first end and a second end, the first end being heavier than the second end, the second weight having a first position wherein the first end is positioned at the closed end of the second receiver tube and a second position wherein the second end is positioned at the closed end of the second receiver tube.

11. The golf club head of claim **10** wherein the second weight comprises a plurality of second weight members releasably connected together.

12. The golf club head of claim **11** wherein the second weight members have different weight values.

13. The golf club head of claim **1** wherein the receiver comprises a first receiver tube, the weight positioned in the receiver tube through the open end, and a threaded fastener received in the open end enclosing the weight in the first receiver tube.

14. The golf club head of claim **1** wherein the receiver comprises a first receiver tube positioned at the interface area, a portion of the first receiver tube being visible in the void.

15. The golf club head of claim **14** wherein the first receiver tube has a window therein.

16. A golf club head, comprising:

a golf club head body having a front, a rear, a crown, a sole, a toe and a heel;

a v-shaped void formed in the rear of the golf club head body, the void extending from the rear of the golf club head body toward a central region of the golf club head body and having a greater width along a rear edge of the golf club head body than in the central region of the golf club head body, the void extending from the sole the golf club head toward the crown of the golf club head body; and

an adjustable weight arranged proximate the v-shaped void, the adjustable weight being positionable in a first position providing a first weight arrangement and a second position providing a second weight arrangement;

wherein the adjustable weight is accessible via the v-shaped void; and

wherein the body defines a receiver tube positioned proximate the central region of the golf club head, the receiver tube extending from proximate the crown of the golf club head to proximate the sole of the golf club head, the weight positioned in the receiver tube.

17. The golf club head of claim 16 wherein the weight has a first end and a second end, the first end being heavier than the second end, the first end being positioned in the receiver tube proximate the crown to provide the first weight arrangement, and the first end being positioned in the receiver tube proximate the sole to provide the second weight arrangement.

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